MACHINE DESIGN

PARTS • MATERIALS • METHODS • FINISHES

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Topics

THE word "streamlining" has apparently become an accepted part of our speech, but we heard the major objection to its careless use being emphasized the other day. A chief engineer, while not decrying the aptness of streamlining for describing some kinds of machines, pointed out that the original meaning of the term was being obscured. He called attention to the fact that streamlining applies to bodies in motion, hence the word is a misnomer when applied to stationary machines, even though their appearance and performance may be improved through teardrop shapes and flowing curves. A better word? Our engineer offers "Cleanlining." MACHINE DESIGN's center spread this month, incidentally, features a number of outstanding stationary machines, which show an unmistakable trend toward a cabinet-type construction.

♦

A NEW process known as "stannising" for coating brass, copper, iron, zinc and other metals with tin has been developed in England, and is applicable to fabricated articles of complicated shape. Pieces to be coated are suspended in an atmosphere of hydrogen and vapor of stannous chloride at a temperature of 500 to 600 degrees Cent. Hydrogen, in contact with a metal surface, reduces stannous chloride to tin, which then plates the piece.

♦

WHAT subjects should be offered embryo engineers in college? Doubtless every engineer, having been "through the mill," has his own convictions. Two opinions expressed recently, while slightly divergent, aim at the same objective: Preparation of the graduate for a well-rounded, socially-useful life. W. E. Howland, Purdue university, feels that conventional required courses in English, economics, and other non-technical fields are not the most efficient ones for giving engineering students the balanced perspective they need. Prof. Howland advocates substitution of studies in the history of engineering and of engineering sciences, in the belief these subjects could, if developed and taught attractively, supply many values of usual non-technical courses. At Carnegie Institute of Technology, however, a program of related social and cultural studies is being started which will occupy approximately one-fourth of the engineering student's time, the remainder to be devoted to purely technical pursuits. Basis for this plan, under the direction of Willard E. Hotchkiss, is the belief that technological progress has far outstripped social adjustment, partly because of insufficient thought spent on the social consequences of mechanized civilization. The place for bringing about greater understanding, it is believed, is in educational institutions.

♦

IMPORTANT changes in design are expected to result from applications of new fiber glass being made by several companies. Owens-Corning Fiberglas Corp., formed and financed jointly by Owens-Illinois Glass Co. and Corning Glass Works, is drawing glass into fibers two ten-thousandths of an inch thick. It expects to draw glass much finer than the most delicate spider web. One notable use of this glass has been as insulation for electric motors, whose weight and size are said to be reduced markedly. Because of the high heat resistance of this insulation, motors have taken severe overloads and have operated at far higher temperatures than those previously possible. Impervious to acids and unaffected by moisture, Owens-Corning fiber glass will also be applied as pipe covering, blankets for steam turbines, sound insulation for airplanes, and as air filters. Goetze Gasket & Packing Co. Inc., another interest in the field, is making glass fiber gaskets which are soft, pliable, resilient and resistant to all acids except hydrofluoric. Glass fiber packings have been made for centrifugal and reciprocating pumps, valve stems, and similar uses.

♦

A SIGNIFICANT trend in airplane diesel engines is indicated by word of a new 2000-horsepower unit being built in Germany. It will have 24-cylinder, four-crank design instead of six-cylinder, two-crank construction. Frequent predictions have been made that a greater number of smaller cylinders would be incorporated in future engines, instead of large, highly stressed cylinders. The new engine will also be outstanding because of its efficiency and reduction in weight. At 3000 revolutions per minute there will be 144,000 power impulses per minute from its 48 pistons, compared with 21,000 power impulses for a 14-cylinder gasoline engine. Weight will be about one pound per horsepower, approximately the same as a gasoline engine. The new engine will be not over 39 inches in diameter, with a frontal area of only 8¼ square feet.

MACHINE
DESIGN

Can Processes Carried Out by Machines Be Patented?

By
George V. Woodling

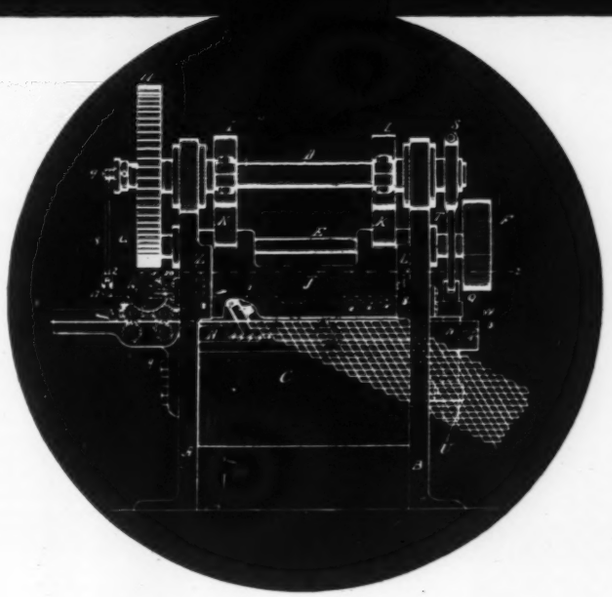

Fig. 1—Patent was issued covering a process for making expanded metal such as illustrated at left

TO FACILITATE the manufacture of products machine designers are called upon to design machinery for carrying out the process by which the products are made. In the development of the machines the designer may also improve the process by reducing the number of steps, by rearranging the order of the steps, or by approaching the problem from a different angle. In such a case, if both the machine and the process are novel, he may obtain both mechanical and process claims in his letters patent. Some of the older decisions held that a process in order to be patentable had to involve chemical or other elemental action. But this definition has been modified by later decisions and now it is established that a process may be patentable even though it consists of mechanical operations and does not involve chemical change.

One of the important cases involving the validity of a process having steps carried out by mechanical transactions arose with reference to the manufacture of expanded sheet metal somewhat similar to that illustrated in *Fig.* 1. The claim describing the process reads as follows:

> "The herein described method of making open or reticulated metal work, which consists in simultaneously slitting and bending portions of a plate or sheet of metal in such manner as to stretch or elongate the bars connecting the slit portions and body of the sheet or plate, and then similarly slitting and bending in places

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alternate to the first-mentioned portions, thus producing the finished expanded sheet metal of the same length as that of the original sheet or plate, substantially as described."

In a lengthy opinion discussing the interpretation of the patent laws in connection with the above claim, the Supreme Court reached the conclusion that "an invention or discovery of a process or

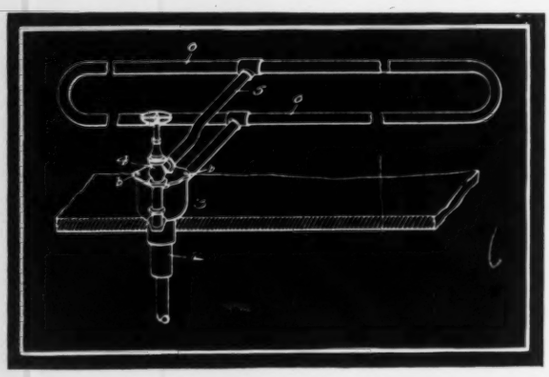


Fig. 2—Process claims were declared not valid on this thermostatically-controlled device

method involving mechanical operations, and producing a new and useful result, may be within the protection of the Federal Statute, and entitle the inventor to a patent for his discovery."

Machine designers who recognize that processes may be patentable when carried out by mechanical operations, often can visualize a larger scope of protection for their discoveries. The new process may be performed by using an old machine in a mode in which it was never used before or by developing a new machine designed particularly for the new process. In either case the patentability of the process is in no degree dependent upon the characteristics of the principle of the machine, although the machine is essential to the process and although the machine required a particular design for carrying out the process. In other words, the mere *function* of the machine cannot be the subject of a lawful process patent, as distinguished from a true patentable process comprising the series of acts performed in making the product.

That is to say, each claim in a process patent must disclose a series of steps performed upon the subject matter, transformed into the product. The patentability of the series of steps depends upon the novelty of one or more of the steps or the order of the steps. The Courts have considerable difficulty in ascertaining whether a claim sets forth a mere function of the machine, as distinguished from a series of acts, which is a true process. The process claimed must contain an intelligent description of the acts which constitute the steps of the process. If all the acts are merely the results following the operation of a specific machine and are necessarily restricted to that machine, then the validity of such process claims cannot be upheld. On the other hand, if the mechanical transactions may be performed by several machines differing in design, or by hand, then the validity of the process claims may be sustained.

Process Claims Not Upheld

If a distinction such as this were not made, inventors could obtain a monopoly upon a machine by means of a process patent when the machine itself did not qualify for a patent. Thus, the inventor of the thermostatically controlled heating arrangement in *Fig.* 2 attempted to cover the function of the device by process claims which set forth the method of controlling the delivery or expansion of steam in radiating pipes by a thermostatic device functioning under the heat of the discharging steam. The Court held that the process claims merely recited the function of the thermostat and the valve operated by it and thus were not valid. The operation of the heating system is inseparable from the mechanism and could not conceivably be performed by hand. Steam is dealt with, and the act performed was the liberation or expansion of steam into the radiating pipes at a rate controlled by the expansion of the thermostatic device under the heat of the discharging steam. It was held that these operations are the functions of the thermostat and the valve

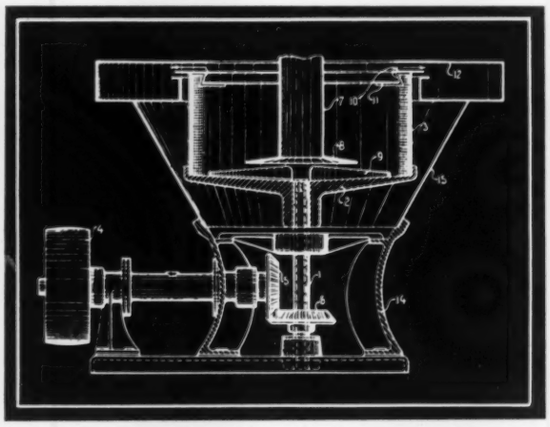


Fig. 3—Claims for this centrifugal machine used in paper making also were declared invalid

which it operates, and that the process could not be performed without the mechanism.

The distinction between a true process and a so-called mechanical method which is no more than the function of a specific machine, is a fine one. The chief distinction seems to reside in the fact that if the alleged method is inseparably associated with the machine or an exact mechanical equivalent thereof, then the method merely recites the function of the machine. More specifically, a process claim which

states the actions of a definite machine designed to operate only according to a fixed invariable rule, is merely defining the law of action or function of that machine and is not recognized as a separate patentable subject. On the other extreme, if the mechanical transactions are clearly independent of any particular mechanism and can be performed by hand with or without machinery or equipment, then the transactions may be described as a valid patentable process.

Between these two extremes there lies an intermediate zone of mechanical methods where certain steps are defined in a process claim describing the machine and thereby inserting structural limitations in the claim. In this zone, the insertion of structural limitations is fatal to the patentability of such methods, where these limitations tend to give a monopoly upon the machine by means of a process patent. The creation of a monopoly upon a machine by process claims is what the inventor tried to do in the case of the machine and process for freeing paper pulp from impurities, *Fig.* 3. He obtained both mechanical and process claims, but the defendant designed around the mechanical claims and suit was brought solely upon the process claims. The determining question was whether or not the process claims were merely the function of the machine. One of the process claims in suit reads as follows:

> "In a process for removing impurities from paper pulp or other fibrous material, continuously supplying the pulp to a centrifugal separator, rotating the separator at a speed sufficient to accumulate the pulp in a substantially cylindrical layer, collecting heavier impurities at the outside of the layer, collecting the lighter impurities at the inner surface of said layer and discharging the purified pulp from between the said impurities."

In the paper making art, whether the stock is wood pulp, rag, or other fibrous material, it is desirable to remove the impurities such as sand, grit, or metallic substances, and the higher the quality of the paper to be produced, the greater the importance of the complete elimination of impurities. This is particularly true in the manufacture of fine bond or writing paper and in the manufacture of paper used in the electrical art, where the presence of even minute metallic substances impairs its insulating characteristics.

The conventional method utilized for removal of impurities was by running a paper stock through a sand trap or grit retainer, the pulp having to flow over successive bars in a trough whereby the heavier impurities were separated from the stock by the force of gravity. The inventor of the machine shown in *Fig.* 3 approached the problem from a different angle and sought to substitute for the sand trap, a centrifugal device by which the heavier particles would be thrown from the pulp by centrifugal force.

In the trial of the case, the inventor, in order to save the validity of the process claims, endeavored to show that other machines besides his own could carry out the process. But all of the other machines

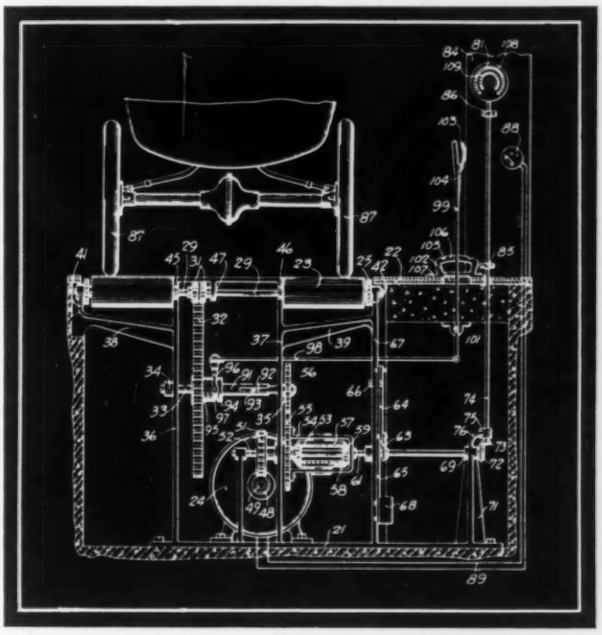


Fig. 4—Automobile brake testing method was patentable because claims were not restricted to use of the inventor's particular equipment

were centrifugal separators. In holding the process claims invalid, the court said:

> "A process which cannot be described otherwise than by describing the characteristic function of a machine is not validated by showing it may be carried on by another machine which has the same characteristic function in respect to the precise result to be attained."

The same question arose in connection with the method for testing automobile brakes, shown in *Fig.* 4. One of the claims in question reads as follows:

> "A method of testing the brakes of vehicles comprising separately rotating a plurality of the wheels thereof, braking said wheels as desired and selectively connecting a single indicating mechanism to the desired wheel to ascertain the brake resistance."

In this case, it was decided that although the process claims involve the use of apparatus they were in no way restricted to the use of the inventor's particular equipment. The claims were accordingly held proper.

Even though the courts permit the injection of structural limitations in process claims, yet such limitations should be avoided in the drafting of claims as much as practicable. The presence of structural limitations tends to make an otherwise true process claim read as if it were a statement of the function of the machine.

Scanning THE FIELD FOR Ideas

Piston, Dashpot Action Control Recoil

IT OFTEN becomes necessary to provide some means of taking up recoil actions in equipment. One design that has demonstrated its effectiveness by continuous use since its invention many years ago is seen on a whaling gun used to fire a harpoon and originated by Svend Foyn, a Norwegian whaler.

Gun is made either as a muzzle or breech loading type. In the accompanying cross section is shown a 90-millimeter gun, perhaps the most interesting part of which is the recoil mechanism. Gun tube (1), recoil cylinder (2) and gun cradle (3) are mounted on the pivot yoke (4) which turns in a heavy post located in the bow of the whaling steamer.

Recoil mechanism consists of three parts, each having its specific function: The first is the recoil brake consisting of piston and rod (5) working in the liquid (glycerin and water) filled cylinder (2). Piston and rod connect rigidly to the gun tube. During the recoil, liquid is forced through the apertures in the piston, thus acting as a dashpot to absorb the recoil.

Second element is the counter-recoil spring (6). Its function is to furnish the force necessary to bring the gun tube back into firing position. The third element, the counter-recoil buffer, prevents any heavy shock or jar as the gun returns to firing position.

Amount of recoil handled effectively by this mechanism can be seen from a consideration of the projectile fired. This gun employs 16 to 20 ounces of black powder to shoot a 6-foot, 160 pound harpoon.

Remote Control Has No Wires

ELECTRICAL equipment has been remotely controlled for some time. However, controlling equipment without any wires to the control point is

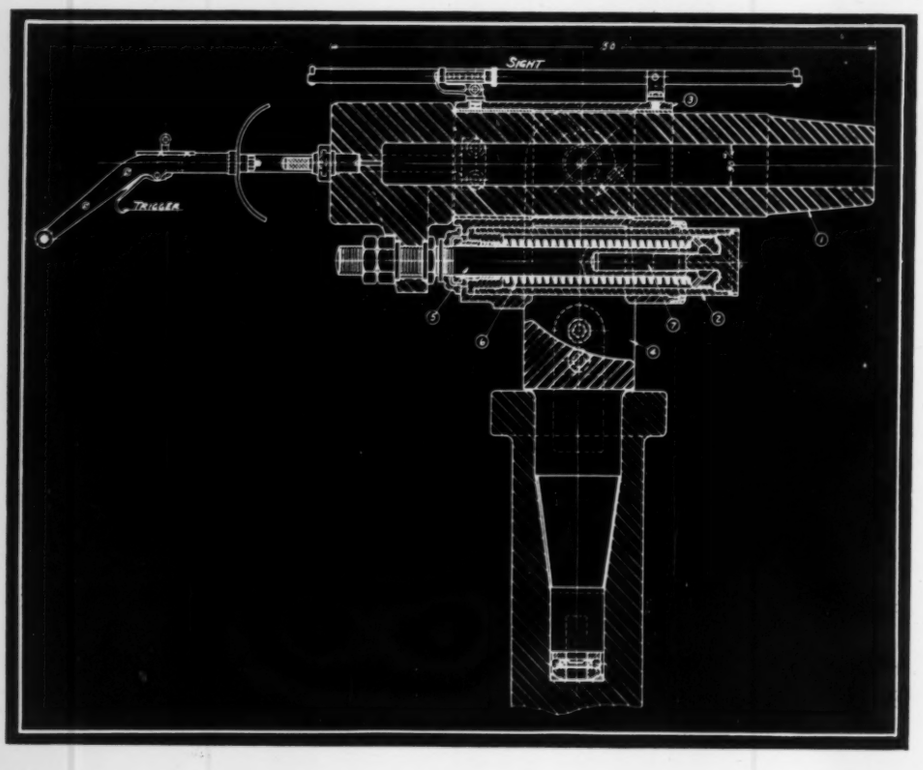


Fig. 1—In this whaling gun, the recoil is absorbed by a heavy spring which then returns gun to firing position slowly as apertures in the piston control flow of liquid re-entering spring chamber

a new development seen in the "mystery control" unit announced by Philco Radio & Television Corp.

Designed for the remote control of radio receivers, the principles employed are equally applicable to other devices and so may find use in many other forms. The control unit consists of a small box suitable for carrying around the house or the plant. In the box are a battery and an impulse generator controlled by a mechanism like an automatic telephone dial. Impulses radiated from the control box are picked up at the control unit of the receiver, amplified and made to operate a stepping switch which in turn actuates relays to select stations, adjust volume, switch devices on and off.

As far as radio operation is concerned, interference between units controlling sets in apartment houses or other nearby locations is avoided by tuning the impulse transmitters and receivers so each receiver is sensitive only to impulses from its own transmitter.

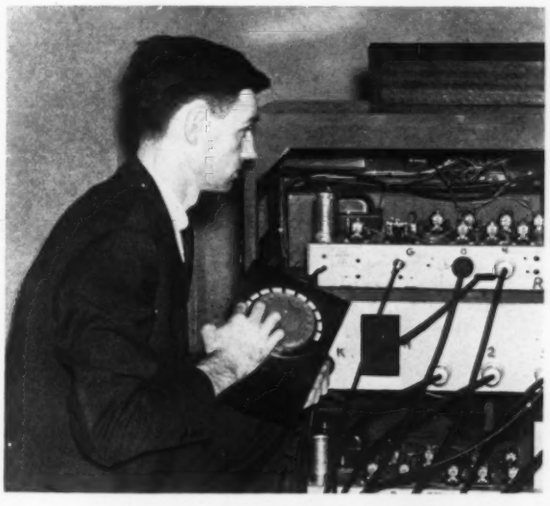


Fig. 2—Small box affords remote control of equipment with no wires thus furnishing unlimited portability

Fastener Has Thickness Compensation

WHERE considerable pressure must be developed in small space with a simple mechanism, the design employed in the Paper-Welder, made by Service Industries Inc., may be of interest. As will be noted by examination of the accompanying cross section, the handle of the device actuates a cam which transfers pressure to the corrugating dies through a leverage. Result is that high pressures are easily produced at the dies to join sheets effectively by an embossing action.

An important element in such a device is provision for different types of paper and number of sheets. The unit shown efficiently handles a range from two tissue paper sheets up to as many as eight or ten

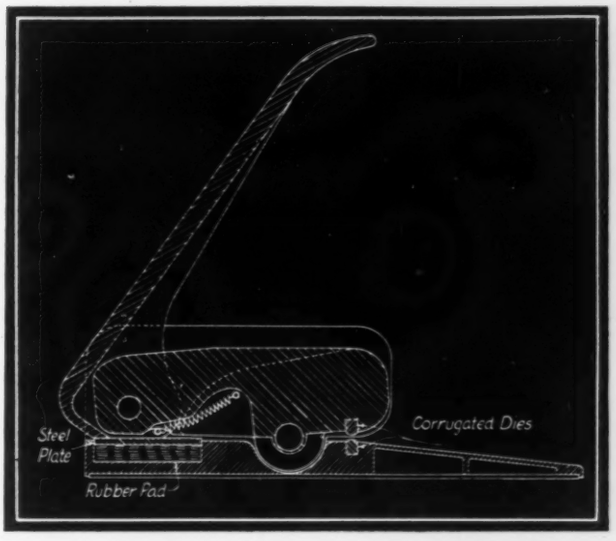


Fig. 3—Paper fastener develops high pressures through leverage and cam. Sponge rubber compensator used

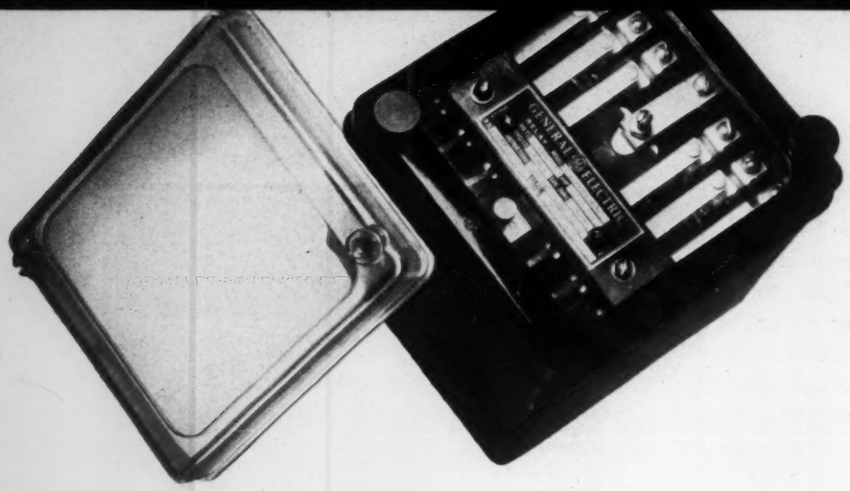
sheets of bond paper. Compensation for various thicknesses involved is provided by a pad of sponge rubber placed under the steel plate against which the cam operates. This material permits developing a certain amount of pressure at the dies with say two sheets of paper. Adding more sheets increases the pressure slightly but not as much as if the pad were not involved. This prevents overloading the fastener as any thickness of sheets can be handled up to the number permitted by the die opening.

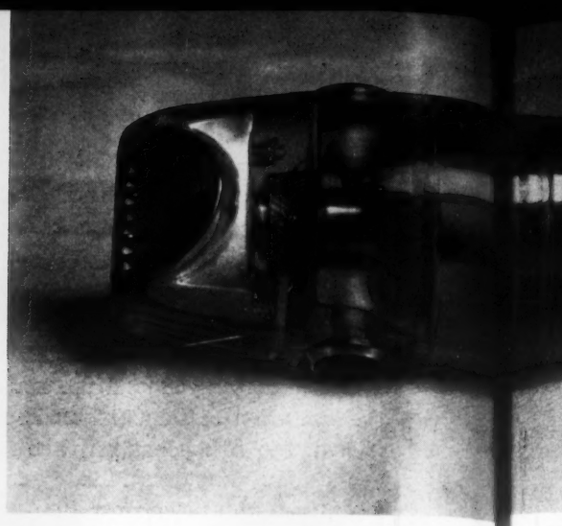
Turbine Drives Grinder At High Speed

TO ELIMINATE vibration at the high speed of 75,000 revolutions per minute, Onsrud Machine Works Inc., features several interesting design developments in its recently announced Model B-1 tool and die grinder.

Extreme precision is of course the first essential. Ball bearings are 8 millimeter open type, selected from precision stock and running in texto retainers. Lubrication is positive, force feed type. Oil is fed in through a hollow spindle and driven by centrifugal force through porous bronze spindle plugs which permit a finely atomized film to be deposited on the bearings without excess. One filling of oil keeps the tool lubricated for five hours of operation.

Rotor is a solid, milled, impulse reaction type, single stage turbine. Rotor and chambered spindle are turned from one piece of S.A.E. 3135 nickel-chromium steel, heated to 1450 degrees Fahr., oil quenched and tempered at 800 degrees Fahr., producing a tensile strength of 175,000 pounds per square inch. Housing is linen impregnated formica and employs an aluminum head at turbine end. This tool has a 1/16-horsepower rating weighs only 12 ounces and is cooled by exhaust air.





Transparent Plastics Fill New R

By J. Delmonte

TRANSPARENT plastics are of unusual interest to the machine designer because the unique combination of optical clarity and desirable mechanical characteristics can solve many design problems. Most of the better known commercial organic plastics have appeared at one time or another in transparent form. From a materials standpoint they are more costly than equivalent opaque plastic materials, because their preparation requires absolute cleanliness in the raw materials and the absence of the usual less expensive fillers. Thermosetting as well as thermoplastic materials are available, the heat-hardenable transparent plastics being of more recent origin. Possessing the molding characteristics of the more common opaque types, all transparent plastics can be molded under pressure to final form. The thermoplastic materials are particularly suited to injection molding operations, lending themselves to the rapid production of small parts at low unit cost.

Engineering Applications Are Listed

Engineering applications of transparent plastics fall into many categories. From their first appearance as "organic glasses," substitutes for the hard inorganic transparent sheet glass, they have found their way into many fields of engineering design. Prominent applications include:

1. Replacement of glass windows where breakage is frequent as on inspection panels, bulletin boards, instrument covers, etc.
2. Substituting for inorganic glasses for flexibility as well as transparency as in photographic films, windows on transportation vehicles, spectacles, watch glasses, etc.
3. Where high dielectric qualities and freedom from dyes, pigments and fillers are imperative. This also would include transparent plastic insulating foils and threads widely used by the electrical industry.
4. For decorative effects in styling machines and products. During the past year stylists have displayed increasing interest in clear and colored transparent plastics.
5. Manufacture of safety glass has employed, since 1931, large quantities of transparent plastics.
6. Experimental models of small machines with parts molded or machined from transparent plastics to ascertain clearances between assembled parts.
7. Application of transparent plastics in photoelectric analysis, highly important to the design of structures where mathematical stress analysis usually is only approximate.
8. Preservation of samples and specimens in cast transparent plastics, applicable primarily to botanical and biological specimens but useful for metal parts as well.
9. In practical light polarizers such as "Polaroid" which uses a transparent cellulose plastic base in the manufacture of the light polarizing medium.

Before examining specific examples of these applications and undertaking an analysis of the engineering merits of the materials selected, a review of the commercial organic plastics and their comparative properties may prove enlightening. Of the transparent plastics the thermoplastic types have the greatest utility, and in some instances greater permanency of physical characteristics. On the other hand, the heat-hardenable qualities of transparent phenolic plastics are of particular utility at high temperatures, where thermoplastic types soften and undergo considerable flow. Plastics employed for their transparent properties include:

CELLULOSE PLASTICS—One of the first plastics to be

Relay case at extreme left is shown with metal and glass cover. The transparent plastic cover alongside affords a better view of interior and will not break. Transparent shaver case at immediate left adds sales appeal by permitting user to watch operation

Role in Design

applied for its transparent properties was nitrocellulose. Though it has been supplanted by other cellulose esters more resistant to flame and weather exposure, it is still widely used in many industrial lacquers. Cellulose acetate first came into prominence as the transparent plastic layer in safety glass construction. Other transparent cellulose plastics of note are the mixed esters; cellulose aceto-butyrate, and the cellulose ether, ethylcellulose. Ethylcellulose as well as cellulose tri-acetate are available in thin transparent film form, useful as electrical insulation. The majority of the cellulose plastics are tough, elastic and capable of withstanding mechanical shock.

VINYL PLASTICS—The most prominent of the vinyl plastics, polyvinyl chloride-acetate, is available in transparent form but it does not possess the stability of characteristics of some of the cellulose plastics. Another vinyl resin, polyvinyl acetal, prepared by the hydrolysis of polyvinyl acetate and condensation with an aldehyde, is used in the manufacture of safety glass. In addition to its transparent qualities it is capable of great elongation, though the elastic recovery proceeds at a much slower pace than natural or synthetic rubbers.

ACRYLIC PLASTICS—Outstanding among the transparent plastics is the methyl methacrylate plastic which not only possesses high initial clarity but also the ability to retain this transparency under prolonged exposure to ultraviolet light. These materials first attracted attention by their ability to transmit ultraviolet, finding application as glass substitutes in solariums where the beneficial rays of the sun were necessary. Like the cellulose plastics they will fulfill a majority of the applications of transparent plastics listed at the beginning of this article.

POLYSTYRENE PLASTICS—Machine parts are molded of transparent polystyrene because adulteration by dyes, fillers and some plasticizers will adversely affect the splendid dielectric qualities of this material.

PHENOL PLASTICS—Phenol-aldehydic plastics, so useful in many machine design problems, also are available in transparent form. The cast phenolics were the first developed in this connection, though they lacked the heat-hardenable characteristics of the molded phenolics. However, cast transparent phenolics

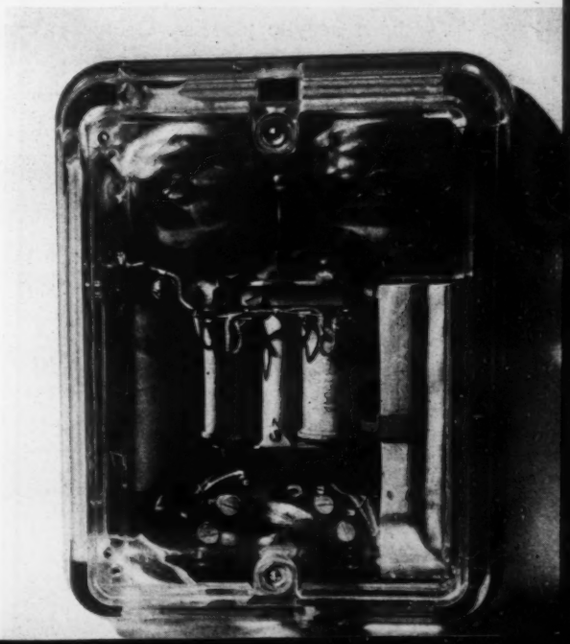
Telephone case of transparent plastic material, below

J. DELMONTE

AUTHOR of the accompanying article, J. Delmonte, also is author of the second book in the Machine Design Series,

"PLASTICS IN ENGINEERING"

Mr. Delmonte is well known to readers of this journal as an authority in the plastics field. Contents of his book will be announced in later issues



fulfill an important engineering application in the preparation of models for photoelastic stress analysis. Compression-molded phenolic transparent plastics are relatively new in their introduction to machine parts and designs, though they offer better temperature resistance than other plastics.

Decorate with Translucent Plastics

UREA PLASTICS—Urea plastics find their greatest utility as a translucent rather than transparent plastic, offering many advantages to decorative effects and in the illumination of public rooms.

This list of transparent plastics is rather lengthy. To enable machine designers to comprehend better the relative merits of the different materials, numerous applications will be cited to bring out the outstanding characteristics of each. At first, it may be of interest to compare the materials solely on the basis of optical clarity, as furnished and after 60 days weather exposure. Tests were performed on materials approximately 0.10-inch thick in sheet form. Percentage transmission is based on the total light transmitted through the specimen from a frosted daylight bulb.

Per Cent Light Transmission

Material	As furnished	After 60 days' weather exposure
Cellulose Acetate	90	87
Cellulose Nitrate	89	83
Polyvinyl Chloride-Acetate	87	78
Methyl Methacrylate	92	91
Cast Phenol-Formaldehyde	90	88
Plate Glass	90	90

Replacement of glass windows and inspection panels with transparent organic plastics covers numerous industrial equipments and designs, where frequent breakage was common with the more brittle inorganic glasses. Instrument panels, visual gages, bulletin boards and housings for electrical equipments and relays are a few uses. The housing for the telephone bell box, p. 27, was molded of Diakon and the housing for the relay, p. 26, was molded of Crystalite, both acrylic plastics. Cellulose acetate plastics have been used for similar purposes with considerable success rendering breakage losses negligible.

Other examples of similar applications are in recording instruments, where the charts are placed behind transparent windows which are opened daily for inspection or replacement of charts. Utilization of transparent cellulose acetate sheets, for example, has cut down on breakage.

Small vials for chemicals, meter dial faces and radio dials often benefit through use of transparent or translucent materials, examples of which are illustrated below. A particularly noteworthy use of transparent plastics is in the radio direction finder loop used on transport aircraft. During operation of this radio system, a rotatable loop projects above the main fuselage of the aircraft. By turning the loop to point toward the source of the radio waves, the maximum signal response indicates direction.

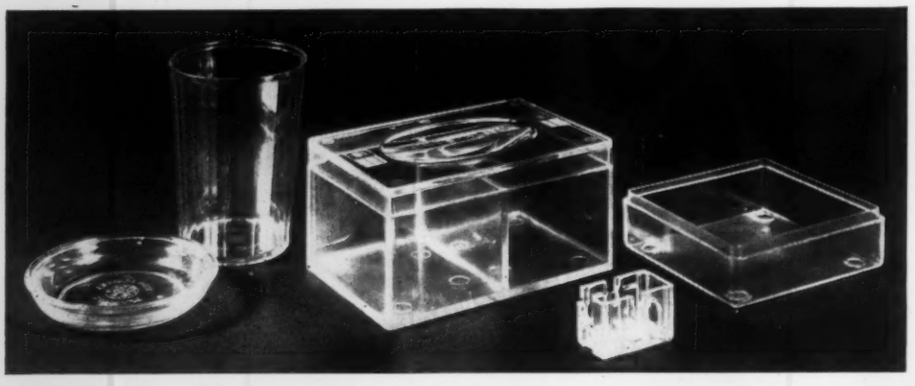
Permits Quick Inspection

Enclosing this loop in a streamlined housing of methyl methacrylate was a novel venture because it not only reduced drag but also minimized static due to weather conditions. Though this streamlined enclosure had been molded of an opaque phenolic material before, the use of a transparent plastic permits ready inspection and enables the operator to ascertain whether or not the loop is rotating satisfactorily.

Use of transparent molded cellulose plastics as containers and stems for oil cans, another recent development, indicates trends in design where transparent plastic parts may serve more satisfactorily than metals. The flexible cellulose plastic will simulate the snap action of the sheet metal heretofore used on the bottom of the can. In general, transparent plastics will provide dust free, oil resistant and chemical resistant molded housings on industrial equipment and accessories.

A special aspect of transparent panels and glasses lies in those installations requiring a certain amount of flexibility and high resistance to shock such as airplane cockpit enclosures subjected to excessive vibration and much stress. Cellulose acetate sheets for these enclosures are shown on p. 29, right column.

Acrylic plastics are used for similar purposes. Relatively thick sections of this transparent plastic have been formed in special molds with the result that gen-

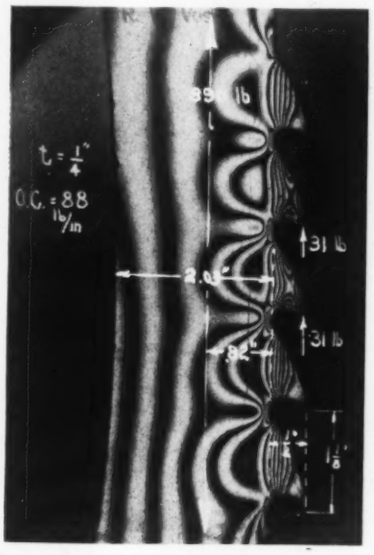


Typical items of transparent plastic show wide range of application possible

erously curved sections of acrylic plastic are found in observation compartments of many aircraft.

Lenses, watch glasses and crystals of many sizes and forms have been molded of transparent plastic. Though the lack of adequate resistance to abrasion has precluded these materials from precision equipment and instruments, they are nevertheless useful on parts experiencing rough handling. "Unbreakable" glasses for pocket watches, known for years, are formed of transparent cellulose plastics. Finally the use of transparent cellulose plastics in photography is well known and so much a part of our daily existence that little attention is given to the materials which make these things possible. Films of cellulose tri-acetate give promise of making available a material that will last longer than present film.

Though the adulterating effects of some fillers, dyes, plasticizers, etc. are evidenced in the dielectric qualities of most plastic materials, they are not quite as pronounced in effect as in the case of polystyrene. This plastic exhibits negligible water absorption and excellent dielectric qualities which make it particularly

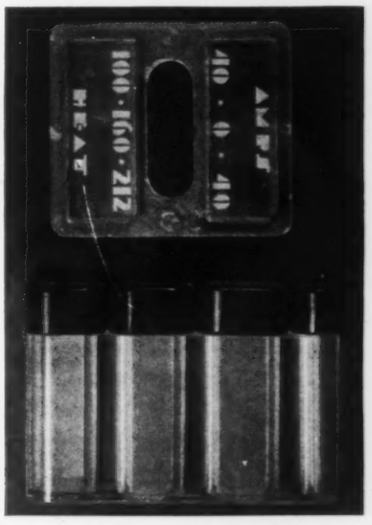


Model used in stress study of saw teeth. This also is made of transparent plastic

useful in electrical equipment. Parts molded from transparent materials seem especially satisfactory.

Some of the better known applications of transparent plastics are in decorative treatments applied to machines. These treatments also include colored transparent as well as translucent articles. A coin box designed for surface transportation vehicles in Chicago, for example, is neatly styled with transparent plastics. At the same time, the conductor may examine the coin that has been deposited. Handles, control levers, illuminating fixtures, buttons, dial faces, etc. are used extensively on many machines. Injection molded transparent plastics feature many of the smaller parts, though as large as 6-ounce transparent parts have been molded by injection methods.

For advertising displays and translucent panels, plastics may be designed to serve many useful and decorative purposes. Artistic displays, name plates and panels with some inscriptions show to good advantage when prepared from translucent colored plastic materials backed up by some light source. Dark, opaque lettering, for example, will stand out sharply on a light background. In this connection, translucent urea plas-



Four containers are combined into one in the case in lower section of this view

tics, both molded and laminated may be found useful.

Thin transparent plastic films are widely used in the construction of safety glass for automobile vehicles and other machines. While safety glass will not prevent breakage, it will resist the scattering and shattering of glass which often endanger life. After breakage, fragments of glass adhere to the thin transparent plastic film which was cemented between two glass plates. This development is carried further in bullet-proof glass by using two plastic layers and three panes of glass, some of which may be specially hardened during processing. In making safety glass, a special effort is made to exclude all air bubbles and to insure a tight bond with a good seal between all layers.

Plastic Film Resistant to Weather

Cellulose plastics, vinyl plastics and acrylic plastics are used in safety glass, cellulose acetate and polyvinyl acetal being the two most noteworthy. Excellent durability of the plastic film to weather exposure is reported. This may be attributed to the presence of a sheet of hard inorganic glass on the outside, which not only resists abrasive action of dirt and sand particles but also excludes ultraviolet rays from the sun, the cause of deterioration in some transparent plastics. A moisture seal or compound along the edges of the safety glass is another useful precaution.

Much interest has been displayed recently in transparent working models of machines or machine parts. The model of the Mt. Wilson observatory telescope and the transparent model of a German automobile engine have both attracted considerable interest. Small elec-

tric dry shavers such as shown on p. 26 have been molded of transparent Bakelite and Tenite, disclosing the working parts to the operator. The use of an operating, transparent, mechanical structure opens up possibilities of examining clearances between moving parts and studying ghost views of machines. It is easy to see where considerable savings may be effected by checking for design errors with transparent models.

Another aspect of transparent plastic models, invaluable to machine design, is the application to photoelastic analysis. These methods allow experimental analyses to be made of proposed structures and machine parts, enabling the detection of weak members or over-stressed parts not always evident in mathematical analyses of complicated structures. Constructive improvements in the design of machines are often realized through these methods.

Highly important in this technique of stress analysis are the transparent plastic models made of the working or load carrying members. These plastic models are machined accurately to scale and stressed as they would be in the final machine. The application of a stress to a transparent plastic model induces temporary

Cowls for airplanes eliminate possibility of breakage with subsequent injury when made of transparent plastic

double refraction which is manifested optically when polarized light is passed through the model. Machine parts frequently studied are gears, frames, beams, fillets, notches, holes and discontinuities of all types in load carrying members.

Plastic materials which have been particularly well suited to photoelastic analysis are the cellulose esters and hardened cast phenolic plastic. The latter, in particular, exhibits a high optical sensitivity and will give well defined lines.

Transparent plastics are readily machined and fabricated into transparent models. Sometimes stresses are induced during machining as in cutting standard transparent gears. It becomes necessary to relieve internal strains in those prepared for photoelastic analysis. This is accomplished by warming the machined models in a well insulated enclosure to a temperature near 115 or 120 degrees Fahr. and allowing the members to cool slowly to room temperature.

A novel and interesting application of cast transparent plastics has been in the mounting and preservation of biological specimens and metal parts. The pieces are suspended in the viscous monomer of the resin, which may be polymerized thermally and catalytically to the hard transparent form with which engineers are familiar, the pieces being permanently imbedded in the interior. Polished specimens for metallurgical analysis have been mounted in this manner, the clear whiteness of the transparent plastic not confusing the analysis of inter-granular corrosion near the surface of the specimen.

Used for Stress Analysis

No review of transparent plastic applications would be quite complete without some reference being made to the development of a practical light polarizing medium known as Polaroid. Minute, needle-like crystals of a sulphate of iodo-quinine, which is capable of polarizing light, are spread upon a sheet of cellulose plastic. As tension is applied to the sheet and the sheet is drawn out, these needle-like crystals orient themselves in a direction parallel to the applied tension. As this occurs the sheet material resumes its transparency, yielding a large surface capable of polarizing light. The uses predicted for this light polarizing medium with its transparent plastic base are enormous, extending from automobile headglare elimination to colored three-dimensional motion pictures.

In conclusion it is proposed to examine some of the limitations of the transparent plastic materials. Outstanding in this respect is the fact that the materials are inherently soft and will scratch easily, marring an otherwise clear surface. Also they lack heat resistance. Some of the more common transparent plastics have relatively low softening points, a disadvantage when the material is to be operated in the presence of some heat. Another common drawback is the change of physical properties with temperatures, some of them becoming quite brittle at temperatures around 32 degrees Fahr. Actual conditions of service alone can determine whether or not these limitations are serious enough to weigh against the many obvious advantages.

AT a recent meeting of the Porcelain Enamel Institute several items of interest to designers were brought out. Much of the detrimental effects of sag may be overcome by proper design, it was claimed, particularly as to gage of metal and distance between supporting points.

Some difficulties experienced in mounting porcelain enameled steel are readily eliminated by use of Phillips head screws and electric screwdrivers with clutches set for correct screw tension. Studies directed towards reducing chipping indicate that specifying a thinner coat of enamel helps to eliminate this tendency.

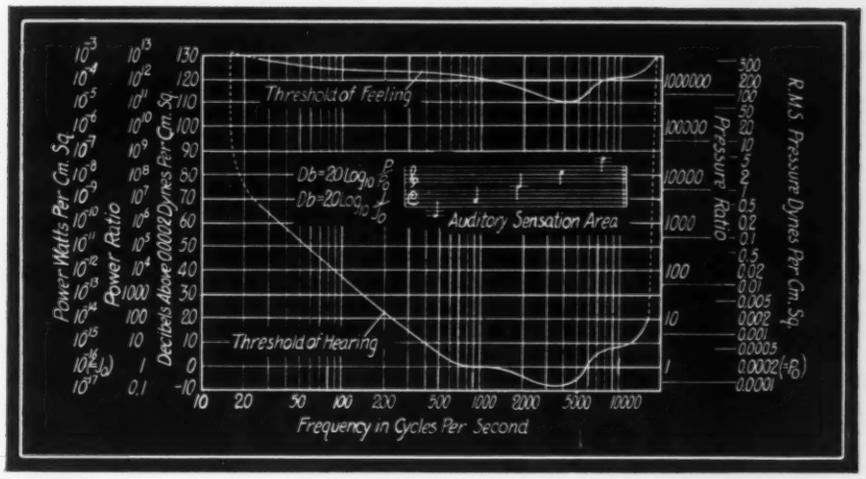


Fig. 1—Diagram of the auditory sensation area, with a musical staff inserted to show range of tones

Analysis of Gear Noises Brings Practical Values*

By R. S. Davidson and L. J. Collins

General Electric Co., West Lynn, Mass.

NOISE in gear sets, a significant problem for some time, has become increasingly important during the last few years because of the higher speeds and powers required and because people in general are becoming more "noise-conscious." Work on gear noise involves such a complex proposition and so many variables that it will take considerably more effort before all potential practical benefits can be achieved. Hence this discussion can only cover the apparatus and methods used thus far in the investigation and will of necessity embrace noise measurement in general.

The human ear is a remarkably sensitive organ, responding to a frequency range of 1000 to 1 to the enormous power range of almost one hundred million million to one, but it is not suitable for use in the investigation of noise. No two ears respond alike and the response of a single ear varies from day to day, even from hour to hour.

Scientific progress in the control of noise depends on accurate measurement, and the modern objective type of noise meter which relies solely on the physical sound for its indications is proving valuable today in many diverse fields.

Just as dirt is defined as "matter out of place," so noise may be defined as undesired sound. Since the desirability of sounds is a matter of individual taste, it is evident that any sound may at times be classed as noise, and that therefore, a study of noise must include a study of all sound.

Physiologically, sound is a sensation usually caused by the stimulation of the auditory nervous centers by vibrations communicated from a vibrating body through an intervening elastic medium, ordinarily the air.

Physically, sound is the vibrational energy which occasions the above sensation. This energy is in the form of a rapid longitudinal wave motion in the medium and is propagated with a velocity characteristic of that particular medium.

The sound wave in air consists of a rapid vibration to and fro of individual particles of air. This gives rise to an alternating pressure variation superimposed on the normal atmospheric pressure. The magnitude of this pressure variation is extremely small, being only about two one-thousandths of a gram per centimeter in the case of sound so loud as to be painful. Yet the ear will respond to pressure variations only one millionth of this.

There are three characteristics of sound: Intensity, proportional to the square of the amplitude: pitch,

*From a paper presented at the fall meeting, American Gear Manufacturers association.

closely related to frequency and for all practical purposes dependent on frequency; timbre or quality, depending on wave shape. A simple or pure tone (given off by tuning forks or stopped organ pipes) is a sound whose wave shape is a simple sine curve. A complex tone is a sound whose wave shape is of any other form.

Fig. 1 shows a diagram of the auditory sensation area. The horizontal scale is a scale of frequency, plotted logarithmically. It is so plotted for two reasons: The frequency range covered is so large that a linear scale would be awkward; the ear recognizes frequencies by octaves or ratios and small differences of frequency are relatively unimportant in the higher frequency range.

There are five vertical scales and we will first consider the one on the extreme right. This is a scale of RMS pressure; that is, the *root mean square* value of the instantaneous sound pressure taken over one complete cycle, given in dynes per square centimeter. The point .0002 has been marked P_o. This pressure corresponds to the average threshold of hearing at 1000 cycles and has been taken as the reference point of the decibel scale.

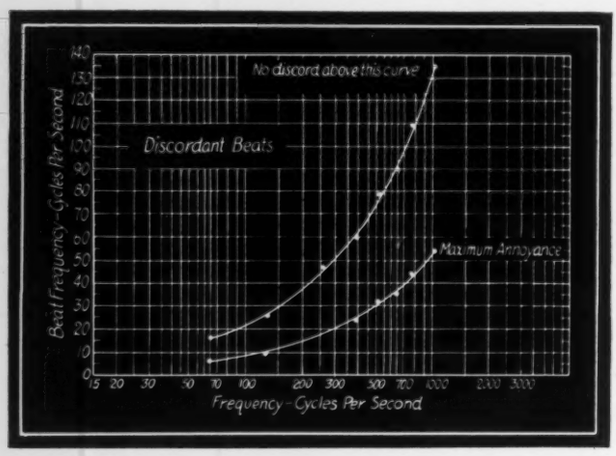

No discord above this curve
Discordant Beats
Maximum Annoyance
Beat Frequency - Cycles Per Second
Frequency - Cycles Per Second

Fig. 2—Annoyance caused by discordant beats varies with the frequency of the beats and with the fundamental frequency of the tones

Adjacent to the pressure scale is the pressure ratio scale, showing the ratio of the pressure at any level to the reference pressure. At the extreme left is a scale showing the actual power flow in a sound beam one centimeter square when the corresponding pressure variation is taking place. The power corresponding to the reference pressure level is 10^{-16} watts, and has been marked J_o. This is the reference power. The next scale to the right is the power ratio scale, giving the ratio of the power at any level to the reference power.

All four of these scales contain very large or very small numbers making them inconvenient for common use. Hence the decibel scale has been adopted. The actual unit is the bel, (named for Alexander Graham Bell), the common logarithm of the power ratio. This unit is too large for practical use so that one-tenth, or the decibel, is used. The relation of the musical scale to frequency is shown by the staff inside the main diagram.

Any point on this diagram will represent a pure tone, in frequency by its horizontal position and in intensity by its vertical position. The curved lines on the diagram represent the average response, determined experimentally, of a large number of ears. Any tone falling inside the area enclosed by the curves will be perceived as a sound. Any tone falling outside this area will not be audible.

Tones Annoying, Though Not Intense

The ear is insensitive to low frequencies, it will be noted, and it is particularly sensitive at about 3500 cycles. This high sensitivity is caused by resonance of the air column in the cavity of the ear. Tones in the neighborhood of this frequency are apt to be very annoying to most people, even though of moderate intensity.

The threshold of hearing curve is the equal loudness contour for the lower limit of hearing of the ear. That is, it passes through the intensity point for each frequency which will give an equal response in the ear. For instance, a pure tone of 1000 cycles and zero decibels intensity is just barely audible, while a pure tone of 100 cycles must have an intensity of 37 decibels before it can be heard at all. A whole family of equal loudness contours can be drawn in between the threshold of hearing and the threshold of feeling and they all will vary somewhat in shape.

Since the response of the ear varies so widely both with the frequency and intensity of sound, it is obvious the physical intensity of a complex sound is not a measure of its loudness.

Noise meters, therefore, are designed with a filter or weighting network which makes them discriminate against high and low frequencies in such a manner that the reading produced by a complex sound is approximately the intensity of a pure 1000-cycle tone which would sound equally as loud as the complex tone being measured.

The following table gives an idea of the power of intensity ratios represented by small steps on the decibel scale:

Decibels	Power Ratio
0	1.000
1	1.259
2	1.585
3	1.995
5	3.162
10	10.000
20	100.000
30	1000.000

When the intensity of a sound is doubled, the intensity expressed in decibels is only three decibels higher than before. Conversely, the noise generated by a machine must be cut in half to reduce the noise level by three decibels.

If two pure tones of nearly the same frequency are sounded together there is a continually changing phase

difference in the alternating pressures between them. When the pressures are in phase, the two tones reinforce each other; when in opposite phase they oppose. In consequence there appears a waxing and waning of the sound, this phenomenon being known as "beats."

Beats of moderate frequency give rise to a roughness of sound which can be very disagreeable. The annoyance caused by such discordant beats varies with the frequency of the beats and also with the fundamental frequency of the tones which are beating. *Fig.* 2 gives a quantitative idea of this variation.

In 1843 G. S. Ohm formulated his law of acoustics. This law states that:

> All musical tones are periodic functions.
>
> The ear perceives simple harmonic vibrations alone as simple tones.
>
> All varieties of tone quality are caused by particular combinations of a larger or smaller number of simple tones of commensurate frequencies.
>
> A complex musical tone or a composite mass of musical tones is capable of being analyzed into a sum of simple tones, each of which may be separately heard by the ear.

Analysis by J. B. J. Fourier's theorem will break down any complex tone into a series of pure tones which added together would produce the complex tones. These tones are called harmonics and are of frequencies which are integral multiples of the fundamental frequency of the complex tone, and of various amplitudes and phases.

The expansion of a periodic function by Fourier's series is generally well known to engineers, and practically this expansion can be applied to any function that persists for, say, 15 or 20 cycles. But in machinery noises we have many single pulses and transients of very short duration.

Such transients, sometimes called "unpitched noise," can be analyzed by means of Fourier's integrals, but the resulting analysis gives a band spectrum instead of a line spectrum as given by the series expansion. That is to say, in any finite frequency range there will be an infinite number of infinitesimal components instead of a finite number of finite components.

Tests Made Where Sound Level Is Low

In our noise tests on machines we have used a sound-level meter. These tests should be carried out in a room where the sound level is low and where the walls are of absorbing material to minimize reflection and consequent interference effects. This is not possible in the case of large units which must be tested where adequate foundations and power are available. In the testing department there are usually a large number of machines in operation and the room level is quite high. In addition there are many hard surfaces present which may give rise to interference effects.

In order to overcome these difficulties it is our practice to take noise readings at a large number of stations about the machine, as many as 25 stations in some cases. The microphone is placed eight inches from the casing in each instance. A correction for the room level noise is then applied to the readings. *Fig.* 3 shows the correction curve used.

In the investigation of gear noise, it is important to know the characteristic frequencies of the normal modes of vibration of the various parts of the assembly. They are easily determined by mounting the part on rubber supports and exciting vibration by electromagnetic means.

Besides the transients which make up the bulk of gear noise, there are also present as a rule musical tones of important magnitude varying from five or six to 20 or more individual components of definite frequency. In some cases, there will be a single com-

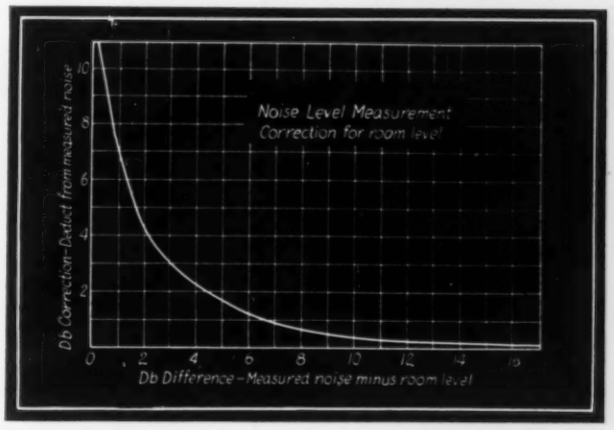


Fig. 3—Correction for room level level noise is applied to readings taken by a sound level meter

ponent of much higher value than the rest. This seems to be the most objectionable type of noise and is known as a whistle. Experienced observers listening to two gear sets, one with an outstanding single component and one without, will judge such a set bad even though the total noise measures considerably lower than the total noise of the set without the large single component, which they judge good.

Gear noise is caused by faulty tooth contour, misalignment of shafts, errors in tooth spacing and errors in helix angle. These errors are so small that they cannot be detected by mechanical measurement. If they were large enough to be so detected, the noise would be intolerable.

Transients may be caused by individual faults on the faces of teeth which only come into contact after several revolutions and thus give single impacts.

The component of tooth contact frequency is probably caused by the fact the tooth contour cannot be made absolutely perfect. This component is usually of small magnitude unless the gear wheel has a normal mode natural frequency very close to the mesh frequency. In this case, the normal mode vibration of the wheel produced by resonant excitation may give rise to a severe whistle. It is possible to change the normal mode frequency of the wheel by changing its dimensions, away from the working face, thus destroying the resonance and effecting a cure.

New Applications Presage

of Low Alloy Steels

USES FOR low alloy, high tensile steels have gradually widened since they became prominent within the past decade. Each year sees applications of these steels in machinery for which they never previously have been specified. Originally developed for use in transportation equipment such as buses, road sweepers, petroleum trucks and railroad locomotives and cars, the low alloys steels grew out of the desire of engineers for structural steel which would make possible increased payload without sacrificing performance.

This movement is a phase of the general trend toward the elimination of deadweight which has so permeated all design of machinery. Research on the part of steelmakers resulted in low alloy steels which not only had much greater tensile strength and higher yield point than ordinary carbon structural steels, but as much as one-half less weight as well. This article will discuss the general characteristics

TABLE 1

Chemical Analyses of Various Low Alloy, High Tensile Steels

Chemical Composition	Structural Open Hearth Steel	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
Carbon	.10–.25	.10 Max.	.12 Max.	.12 Max.	.30 Max.	.40 Max.
Manganese	.30–.60	.10–.50	.50–1.00	.50–1.00	1.25–1.70	.60 Min.
Phosphorus	.04 Max.	.10–.20	.10 Max.	.08–.12	.04 Max.	.04 Max.
Sulphur	.05 Max.	.05 Max.	.04 Max.	.....	.05 Max.	.05 Max.
Silicon	.....	.50–1.00	.....	.05–.50	.30 Max.	.20 Min.
Copper	.20†	.30–.50	.50–1.50	.50–.70	.20 Min.	.20†
Chromium	.....	.50–1.50	.....	.20–1.00	.....	.....
Nickel	.....	.....	.50–1.00	.25–.75	.....	.....
Molybdenum	.....	.....	.10 Min.	.....	.....	.....
Physical Properties						
Yield point, lb./sq in...	25,000 Min.	50,000 Min.*	55,000 Min.**	50,000 Min.	50,000 Min.*	45,000 Min.
Tensile strength, lb./sq in...	45,000 Min.	70,000 Min.*	70,000 Min.**	70,000 Min.	80,000 Min.*	80,000 to 90,000
Elongation, pct. in 2 in.	25 Min.	22 Min.	25	.....	20 Min.	18 Min.
Elongation, pct. in 8 in.	$\frac{1,500,000}{\text{T. S.}}$ Min.	$\frac{1,500,000}{\text{T. S.}}$ Min.	$\frac{1,500,000}{\text{T. S.}}$ Min.	$\frac{1,500,000}{\text{T. S.}}$ Min.	$\frac{1,500,000}{\text{T. S.}}$ Min.	$\frac{1,500,000}{\text{T. S.}}$ Min.
Cold bend...	180°	180°	180°	180°	180°	180°

** For material over ¾-inch thick, inclusive of 2-inch, yield point and tensile strength will be reduced 5,000 pounds per square inch*

*** Addition of .18 per cent carbon, and reduction of .06 phosphorus will make yield point 70,000, tensile strength 90,000, and elongation in 2 inches 15 per cent*

† Minimum — if copper specified

Fig. 1—Weight of cage was reduced 30 per cent through use of low alloy steels, making it possible to reach a mine level 800 feet lower

of these steels and point out how their unusual properties have led to increased employment of them.

Transportation equipment—or, more correctly, mobile machinery—in one form or

ge Wider Use

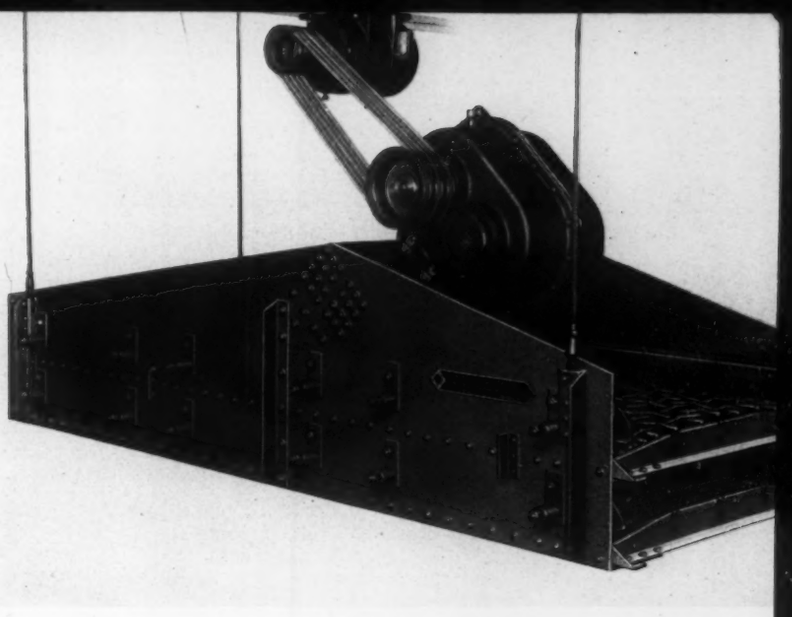


Fig. 3—One of the newer applications of extra-strength steels was for all important members of this low-head vibrating screen

another still constitutes the greater proportion of machines made from these special steels. Indeed, it might be argued that the very nature of extra-strength steels dictates their use in applications for carrying or conveying or moving. Available as shapes, plates, bars, strip, sheets, tubing, etc., the various forms lend themselves to relatively bulky machinery of such a special nature that ordinary structural steel will not be satisfactory and a grade of steel is needed which will permit easier, more profitable movement through reduced weight. The extra strength is an added advantage. *Fig.* 2, showing a roller gate dam on the Mississippi river, looking upstream, is a good example, which will be elaborated upon later.

Frequently it is asked why "low alloy" steels are so called, since ordinary structural carbon steels also have varying amounts of alloying elements. This question is pertinent because it leads to a discussion of the properties of high tensile steels. Perhaps the best answer to the query is the fact that the alloying elements in high tensile steels are put there for certain specific reasons, whereas extra elements in ordinary steels, while important, are nevertheless relatively incidental.

Steels made by different companies vary slightly in analysis, but the principles underlying the additions of alloys are the same. Table I shows chemical compositions of five grades of low alloy, high tensile steels produced by different makers. They may be termed roughly as follows: Grade 1, chromium, copper, silicon, phosphorus steel; Grade 2, copper, nickel, molybdenum; Grade 3, nickel chromium; Grade 4, carbon, manganese; Grade 5, carbon, manganese, silicon. Composition of ordinary structural open hearth steel is used for comparison. The table also includes physical properties of high strength, low alloy steels.

The designer, by studying the properties in the table will appreciate readily the myriad possibilities for application of these steels. Impact strength, a point not mentioned in the table, is considerably greater in general than for ordinary structural open hearth steel. Corrosion resistance is a prominent characteristic, as is resistance to fatigue and abrasion.

The modulus of elasticity of these steels is the same as that of structural quality steel, since no treatment

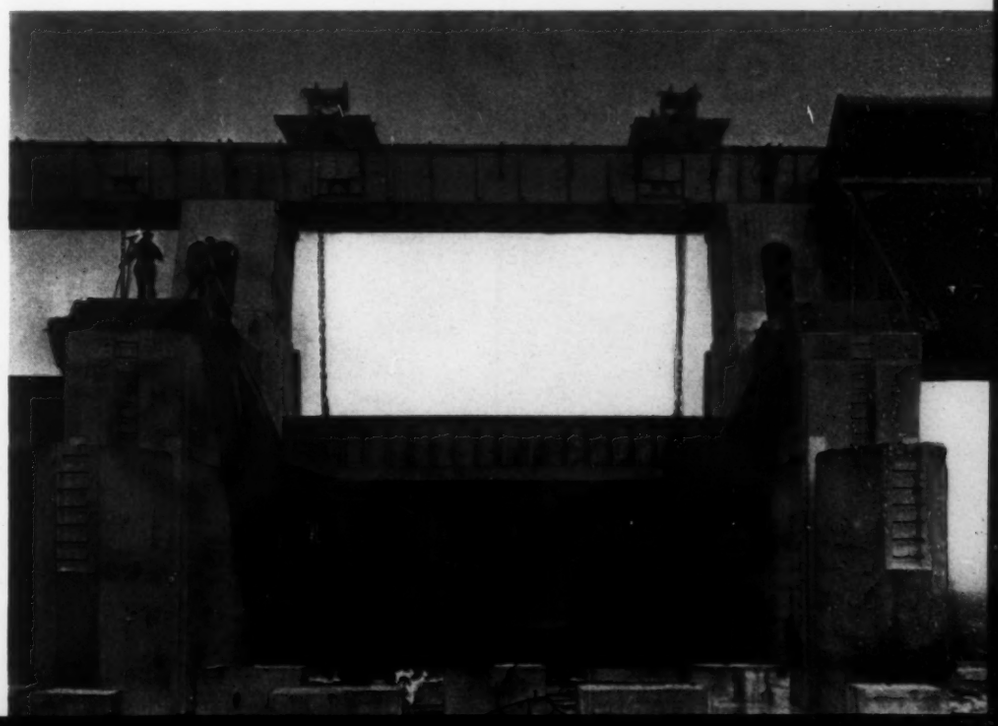


Fig. 2—Tainter and roller gate construction on this river dam was made of two grades of low alloys

—mechanical, chemical, or thermal—is able to effect a change in this quality. This fact must be taken into consideration in a design where deflection is a factor. The same moment of inertia as in the case of ordinary steel should be maintained through the use of ribs, beads, corrugations and other means.

Low alloy steels in general may be handled and fabricated in the same manner as mild carbon steel, with only minor variations to allow for the greater toughness. The diversity of applications frequently requires conversion from the "as furnished" forms into other more complex forms, either by hot or cold forming. Selection of the proper method of cold forming depends on the severity of deformation involved and the thickness of the material. Radii used for cold pressing should be slightly larger than those used for structural quality carbon steels. The higher elastic qualities of these high strength steels will usually cause a greater "spring-back," which must be compensated for.

In cases where cold forming is not practical and hot forming must be employed, high strength steel should be handled in virtually the same fashion as carbon steel. Actual work should be done around 1450 degrees Fahr., although parts to be hot pressed or spun should be heated to about 1625 degrees Fahr.

Welding of these materials may be accomplished by the spot, seam, flash and shielded metallic arc processes, especially because of their low air hardening characteristics. This last condition is important because many large fabricated sections cannot be heat treated after welding. Microstructure, hardness, toughness, and corrosion resistance are not changed appreciably by welding or any other heating operation. Whether or not a welded part is to be stress relief annealed after welding, however, depends on the service, the thickness and other factors. Each case merits separate consideration. If stress relief annealing is to be used, the welded part should be maintained at a temperature of 1200 degrees Fahr. plus or minus 50 degrees for one hour per inch of maximum thickness, followed by slow cooling.

Either high tensile or carbon steel rivets are available for construction with low alloy steels involving riveted joints. Choice of riveting instead of welding should be governed by problems of practical erection and maintenance conditions, and should be dependent on the advice of leading steelmakers. Rivets in the smaller diameters may be driven cold, although hot driving of all sizes is recommended.

The wide range of treatment which designers may specify for machine parts made of these steels should be mentioned. Forgings, under approximately the same temperatures as used for ordinary structural steel, can be made satisfactorily, using both drawing down and upsetting operations. Low alloy steels can be flame cut, although in certain grades they should be preheated to approximately 500 degrees Fahr.

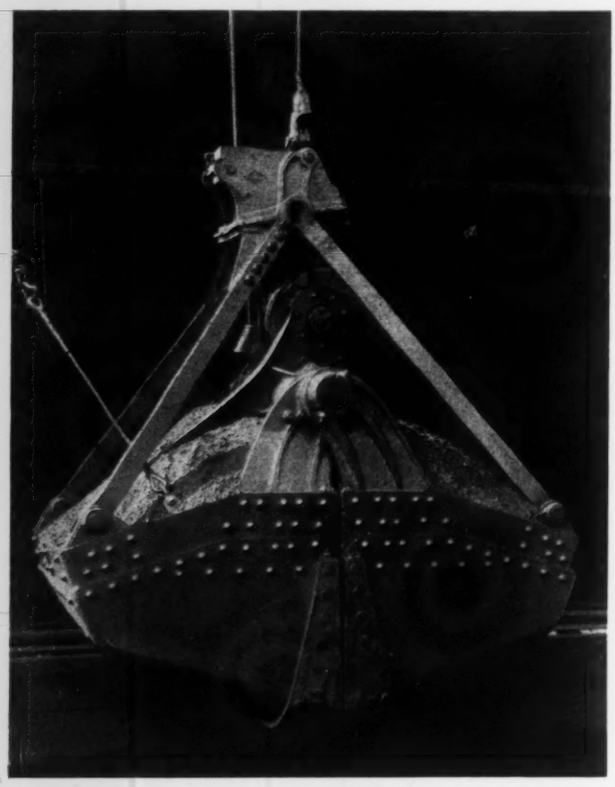


Fig. 4—Above—Reduction in weight through use of alloy steels in this clamshell bucket raised a number of interesting design problems

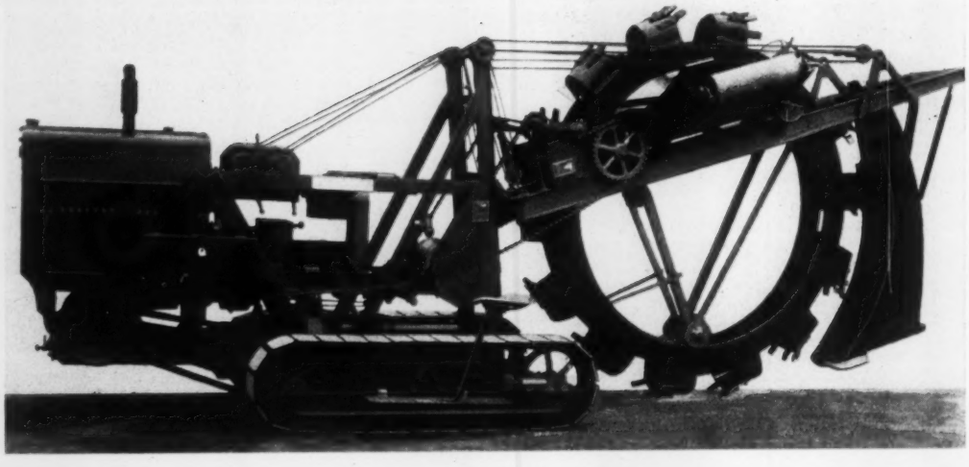


Fig. 5—Right—All structural parts of this trencher are made of low alloys, arc welded and subsequently heat treated

About 25 per cent more power is required in punching these steels than for plain carbon steels. Reaming is virtually the same, but milling and drilling operations are more difficult than with ordinary carbon steel. More pressure under reduced speed is necessary. A cooling agent should be used in drilling operations.

Illustrations in this article have been carefully chosen with particular attention to the savings in weight, gains in strength, expansion in variety of uses, and qualities of the specific grades of high tensile steels used.

A vertical ore skip and double deck hoisting cage is shown in *Fig.* 1. Weight of the cage was reduced 30 per cent, payload was increased. This lighter cage made it possible to reach a mine level 800 feet lower without increasing the rope pull at the hoist. The steel used was of a type providing high tensile strength under conditions where corrosion was not a factor of compelling importance. But since the steel has a min-

Fig. 6—Body of this semi-trailer was reduced almost 47 per cent through use of low alloy structural shapes

imum of .20 per cent copper, it is nevertheless as resistant to atmospheric corrosion as carbon steel with the same copper content.

Fig. 2 shows a dam on the Mississippi river, where tainter and roller gate construction was of two grades of low alloy steels. Parts not requiring specific attention to corrosion were made of the same grade steel as that in the skip and cage in *Fig.* 1. Parts exposed to the atmosphere were fabricated from a grade with slightly less tensile strength, but greater corrosion resistance.

One of the newer applications of extra-strength steels is illustrated in *Fig.* 3, a low-head vibrating screen. All important members of the screen body are made of low alloy steel, including the screen cloth support frame, all the gussets and side plates, and the angles.

The steel plate used in the gas scrubber and electric precipitator for cleaning blast furnace gas shells, shown in *Fig.* 7, is high in nickel, chromium and copper. Corrosion resistance of about six times that of plain structural steel has been attained in this alloy. It has allowed weight savings of from 25 to 50 per cent. Abrasion resistance is 30 to 50 per cent greater than that of ordinary carbon steel.

Although all structural parts, electric arc welded, are made of high strength, corrosion resisting alloys

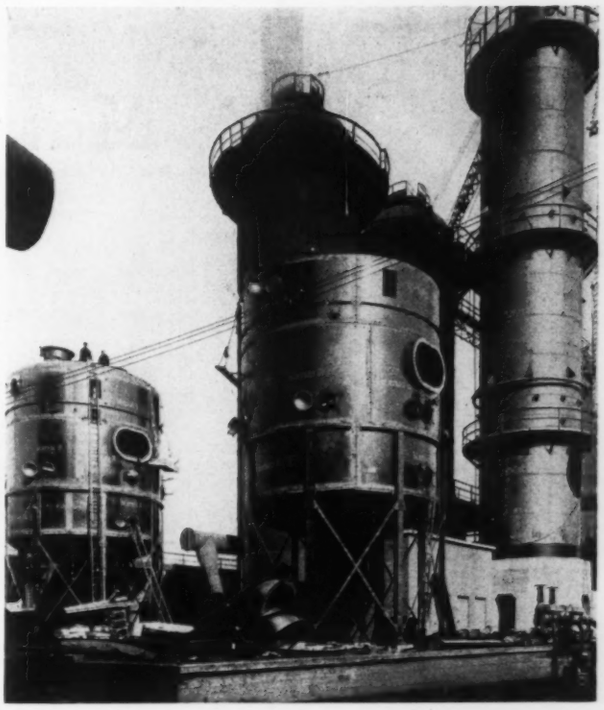


Fig. 7—Corrosion resistance about six times greater than that of plain steel was attained in the plates for this precipitator for cleaning blast furnace shells

in the trencher in *Fig.* 5, the manufacturer plans to expand use of these steels even farther. These members are heat treated. Low alloys have so combined strength with minimum weight that eventually every possible part will be made of them.

A number of interesting design problems are raised by the light weight clamshell bucket in *Fig.* 4. By actual test in unloading a 6000-ton cargo of coal, use of this larger capacity bucket reduced boat unloading time 22 per cent. The use of alloy steels to reduce clamshell bucket weight, however, makes it imperative to be critical of design characteristics that influence digging ability. Sufficient increase in digging power must be provided to counteract any reduction in weight that otherwise would reduce downward lip pressure or digging ability, and penalize payload.

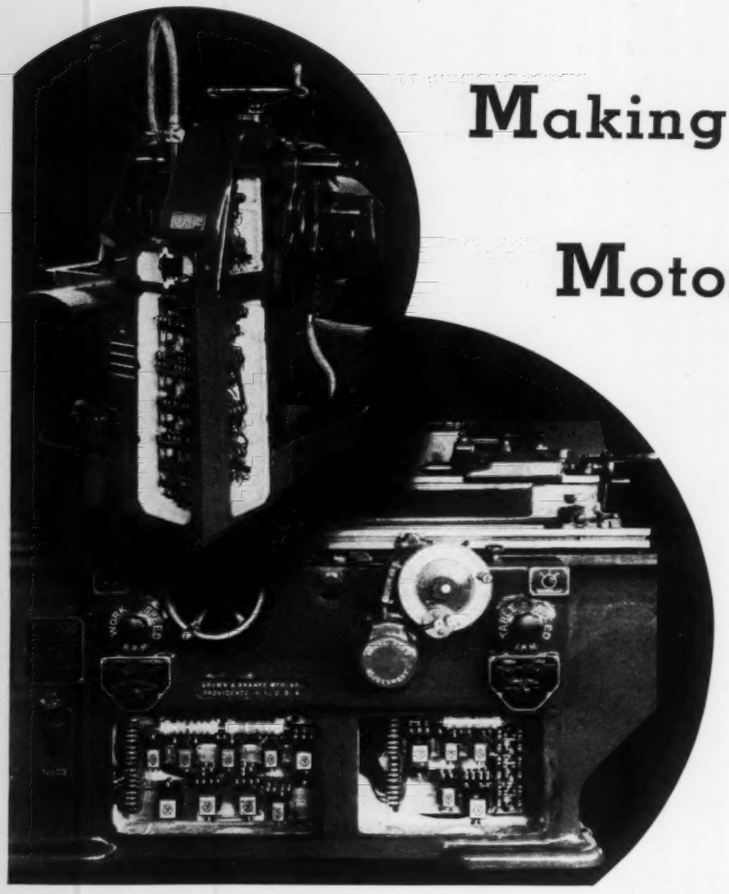
The semi-trailer stake body in the truck shown in *Fig.* 6 was reduced in weight from 4500 pounds to 2460 pounds. All structural shapes are of low alloy steel, with the frame work bent from sheets.

Reduction in weight is frequently a desirable characteristic, but to realize its fullest benefits designers face the task of solving other problems which it raises. Upon their success in this effort may well depend the rapid growth of applications of the steels under discussion.

MACHINE DESIGN is indebted to the following companies for their cooperation in the assembling of material and photographs for this article: Alan Wood Steel Co.; Allis-Chalmers Mfg. Co.; Bethlehem Steel Co.; Blaw-Knox division; Carnegie-Illinois Steel Corp.; Cleveland Trencher Co.; Inland Steel Co.; Link-Belt Co.; Republic Steel Corp.

Making Full Use of Motors and Controls

By B. P. Graves
Director of Design, Brown & Sharpe Mfg. Co.



Cut-away views show use of built-in controls

TO OBTAIN the many advantages possible through using the natural functions found in electric motors and their controls, it is not necessary to build an entirely electric machine. Many of these advantages can be obtained by coupling with either mechanical or hydraulic mechanism. Brown & Sharpe recently developed a new line of plain cylindrical grinding machines (*MD,* April, 1938, pp. 55-57), in which the following combinations are incorporated: Mechanical electric, hydraulic electric, and entirely electric. In the light-type milling machine (*MD,* June, 1936, pp. 30-34) is a good example of a direct-connected motor using the natural motor functions of stopping and starting.

Just how far a designer can go in application of motors and controls will depend a good deal on conditions surrounding his problem, but I do feel the trend in design is fast turning toward the use of electric functions. Many reasons can be given for this electric trend, stated in very general terms as follows: Natural functions, such as reverse, stop, variable speeds; comparative ease in flexing a cable or in conducting electricity around a corner; little effort required for pressing a button or making or breaking a control circuit; many machine functions can be linked together and controlled by a single switch.

Perhaps the greatest advantages of electrical controls result from the interconnection of controls and the linking together of machine operations. By tying together various members in a control circuit it is possible:

1. To simplify the operation of the machine so that production parts may be machined with a minimum number of control movements on the part of the operator
2. To have dual control or start and stop stations wherever they are desired
3. To include many safety features on the machine
4. To include attachments and to make changes which add new movements or operating cycles without seriously changing the standard machine.

In the past, motors were used almost solely as sources of power. They can, however, be used for starting and stopping, and can easily be reversed. If then a motor is to be employed in a machine, the design may well be laid out to use these possible motor functions. Instead of including other mechanisms to start and stop the machine, the motor may be used for this purpose. This feature is brought out in many machines today in which the motor is direct-connected.

The spindle drives of many machines have always included an idler gear, shaft and gearshift lever to give a reverse direction of rotation. With a unit drive, a simple manual reversing switch may be adopted to provide reverse motion. The B & S electric milling machine is a good example of the ease with which a standard machine may be changed to

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From an address given at the Machine Design division, Cleveland Engineering society, Nov. 21, 1938.

Automatic Typewriting by Wire*

By E. F. Watson
Bell Telephone Laboratories Inc.

NOT UNLIKE ordinary typewriters in appearance, teletypewriters differ markedly in actual design. Equipment is included which sends electrical pulses to distant stations simultaneously with operation of the keys. Deciphered at the other end, these pulses are converted into letters as fast as received.

A teletypewriter keyboard is similar to that on a standard typewriter but has a few extra keys for controlling operations and three rows of keys instead of four as it sends only capital letters, numerals and punctuation marks on the standard unit employing 32 signals. However, a special unit permits sending 64 signals where it is necessary to transmit capitals, small letters, numerals and punctuation marks.

The 32 signals are used to send the 26 letters of the alphabet and the machine functions such as carriage return, space and line feed. A shift signal brings into play a second row of type to form ten numerals, fractions in eighths and punctuation marks.

When a teletypewriter key is pressed, projections on the lower side of the key bar select one or more of five circuits depending upon the key depressed. Circuits are connected to segments of a distributor with revolving brushes as shown in *Fig.* 2 so that each of the circuits, if selected, is closed in succession as the brushes rotate.

Thus there are two conditions, "current on" and "current off", for each of five time units enabling a total of two-to-the-fifth-power, or 32, signals to be sent. Using six-unit code with six distributor segments makes possible transmission of 64 signals, two to the sixth power.

At the receiving end, a second revolving distributor, rotating in approximate synchronism with the transmitter, has a series of five magnets connected through it to the line. Line pulses fed to these magnets operate their armatures which in turn control position of five selector bars used to determine what type bar is released to strike the paper.

* *Abstracted from "Bell Laboratories Record."*

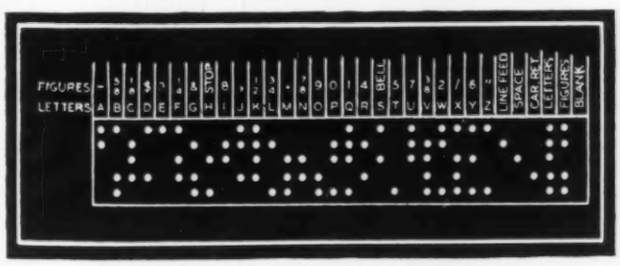

Fig. 1—Teletypewriters send code signals shown above consisting of one or more of a series of five pulses

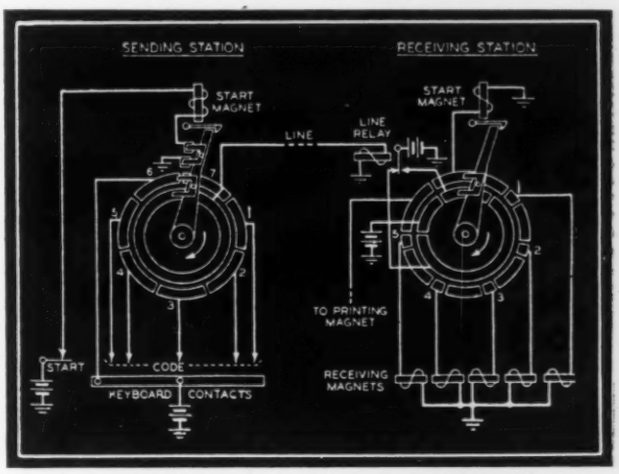

Fig. 2—The code signals are sent and received by distributors which rotate in approximate unison

Sending and receiving units shown in *Fig.* 2 are maintained in synchronism by a start-stop system. Small synchronous motors or governor-equipped commutator-type motors are connected to the brush arms through clutches. Arms are normally at rest with motors running constantly and clutches slipping. Normally the line circuit carries current but when a key is operated, the start magnet or sending distributor releases brush arm which is rotated by motor.

As this brush passes from the sixth to the seventh segment, the line circuit is opened, releasing the brush at receiving station and permitting it to rotate. Both brush arms then revolve at same speed. This now establishes a system for duplication of the code signals required to operate the selector bars which in turn determine what type bar is released to strike the paper.

The start-stop system has a number of advantages in addition to its simplicity, the fact that highly accurate speed regulation of the motors is not required and that to start a station it is only necessary to turn on the power. It provides automatic lag compensation because the receiving distributor does not start until the start signal has been propagated and received, and then the other signals always follow in a fixed definite time relation. Thus any number of receiving stations will operate satisfactorily without adjustment when connected to one transmitter regardless of distances or circuit complications due to repeaters and the like.

Teletypewriter signals often become shortened or

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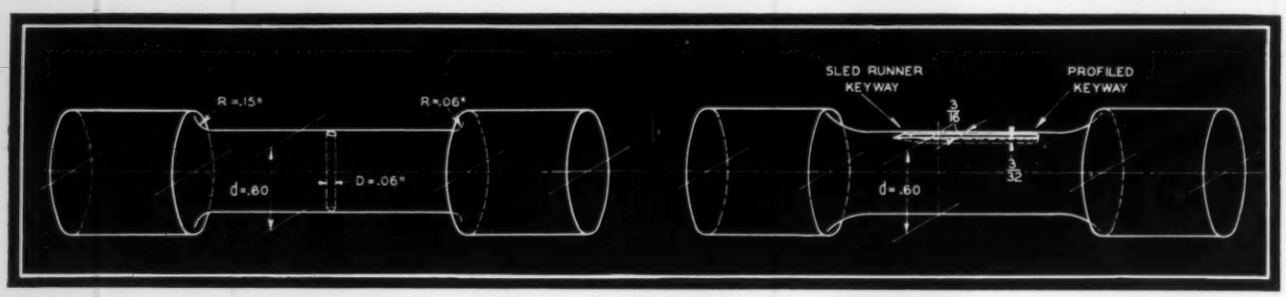


Fig. 1—(Left)—Test piece for stress examination in round shaft with a circular hole through center. Fig. 2—(Right)—Test piece of shaft with sled runner keyway

Photoelastic Stress Analyses Made In Three Dimensions

By M. Hetenyi

Research Laboratories,
Westinghouse Electric & Mfg. Co.

DURING the past ten years engineering research has made wide use of the fact that transparent materials become double refractive when subjected to stress. From the elaborate pattern of stress-lines appearing when a model is loaded in polarized light, a complete determination of the stress system is possible. Bakelite has been found to be the most suitable model material for such tests since it shows the largest number of lines for a given amount of stress.

Photoelastic Method Solves Problem

In many important problems where mathematical treatment has not been possible, the photoelastic method has provided the solution. The method, however, has had an inherent limitation. For quantitative work it is required that along the path of light rays, traversing the model, the stress condition be the same and therefore only sheet models loaded in their own plane could be used. Thus application of photoelasticity has been limited to two-dimensional stress problems until recently when the recognition of a curious property of the phenolic resins has made it possible to determine the stress distribution in machine parts representing actual three-dimensional systems.

Fundamentals of the new method can easily be demonstrated by subjecting a simple Bakelite bar to some loading and then annealing it in that loaded condition. With annealing finished and the load removed, a permanently deformed specimen is obtained. In polarized light it exhibits a pattern of stress lines corresponding to an elastic state of stress. At first sight it seems contradictory that a permanently deformed test piece could represent an elastic stress distribution. Recent investigations, however, show that the structure of Bakelite can be

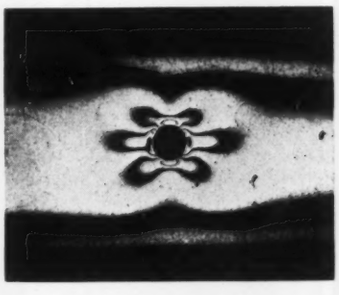


Fig. 3—Horizontal slice taken through pinhole in Fig. 1 test piece

considered as consisting of a strong primary network of molecules branching off in all directions and serving as a skeleton for the bulk of the material. This network has high mechanical strength and is in an infusible state. Its cells, however, are filled with material still in a fusible condition, though chemically the same.

The fusible part of the material is solid at room temperature but its viscosity decreases rapidly when the temperature is raised. At around 110 degrees Cent. it is in a liquid state. The only load-carrying element in the material at this temperature will be its strong primary network, the strength of which is unaffected by the annealing temperature. Deformation of the material at this temperature thus is purely elastic, though its modulus of elasticity is small in comparison with the modulus it has at room temperature.

Leaving now the load on the testpiece and lowering the temperature, deformations will remain the same and the only change is in the fusible part inside of the cells, which returns to a solid state. This surrounds, with its large mass, the stressed and deformed elastic skeleton and keeps it permanently in that condition even when the load is removed. Thus is obtained in a solidified, "frozen" state the elastic deformation produced by the load at the annealing temperature.

Model Shows "Frozen" Stress Lines

Being a function of deformations, the double refractive property of the specimen will also be permanent, and in polarized light the model will exhibit a pattern of "frozen" stress lines representing an elastic state of stress. But there is one more interesting property of the testpiece obtained by the annealing process.

Careful sawing or machining does not disturb the frozen stress lines and so the original pattern will be preserved in any portion cut out of the testpiece. This last point, being also in accordance with the above discussed molecular theory of phenolic resins, completes the possibility of using the method in investigating three-dimensional stress problems. Thin slices cut out of any three-dimensional testpiece prepared by the annealing process will show in a conventional photoelastic apparatus the stresses existing in the original testpiece in the corresponding plane.

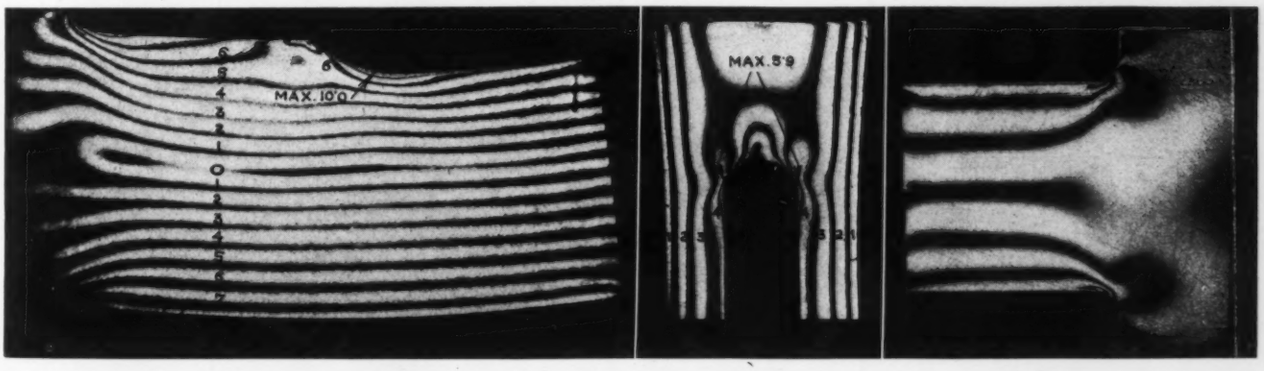
Thin Slices Taken from Testpiece

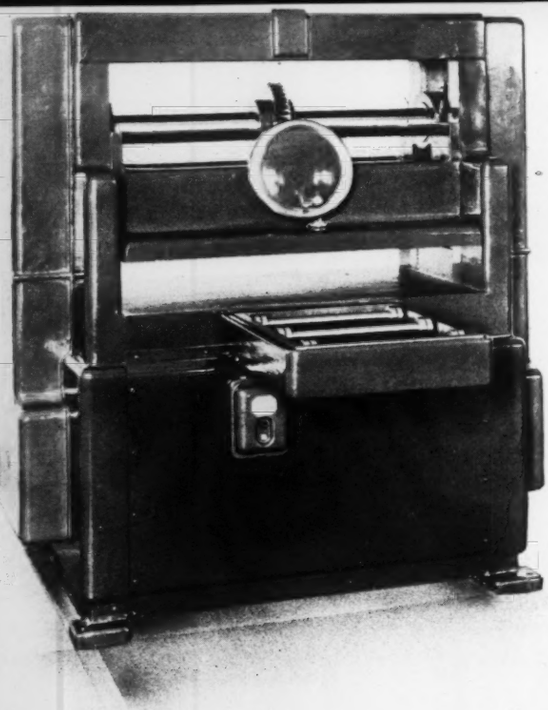
Fig. 1 shows the dimensions of a Bakelite model of a round shaft having two different fillet radii and a transverse circular hole. This shaft was annealed in simple bending and then thin slices were cut out of the piece, a vertical one through fillet and a horizontal one through the transverse hole near the surface. In *Figs.* 3 and 6, the photoelastic pictures of these slices are shown. The stress concentration factors determined from these pictures were found to agree with the results of strain measurements that were obtained on large-size specimens of round steel.

A typically three-dimensional problem, the one of a round shaft with a keyway, was investigated using the Bakelite model shown in *Fig.* 2. After annealing, a vertical slice was cut out in the center line of the sled runner keyway while through the profiled keyway a horizontal slice was taken. *Figs.* 4 and 5 show the stress pattern in the planes of these slices. The stress concentration factors determined from the pictures ($k = 1.38$ for the sled runner and $k = 1.79$ for the profiled keyway) are in good agreement with fatigue test data which were obtained under conditions where agreement might reasonably be expected to exist.

This new method will most likely have an important role in future methods of stress analysis. It seems to have only one serious limitation, namely the testpieces must be deformed considerably at the annealing temperature in order to obtain a sufficient amount of stress lines in the frozen sample. Such large deformations however might be avoided by a suitable choice of experimental technique, and the future developments of the method probably will be made along this line.

Figs. 4 and 5, left and center, show vertical slice through center of sled runner keyway and horizontal slice through the profiled keyway, Fig. 2, respectively. Fig. 6, at right, is a vertical slice through the fillet of Fig. 1 test piece

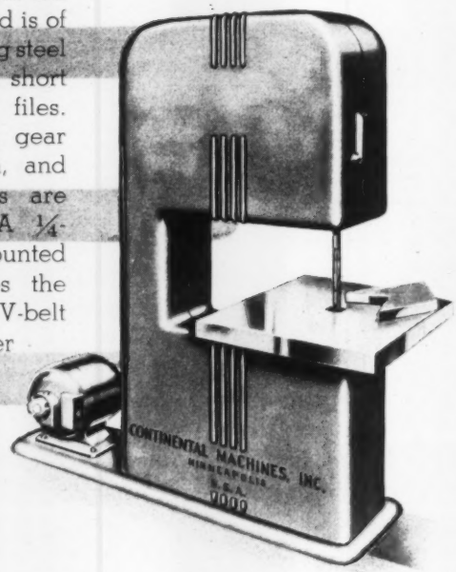


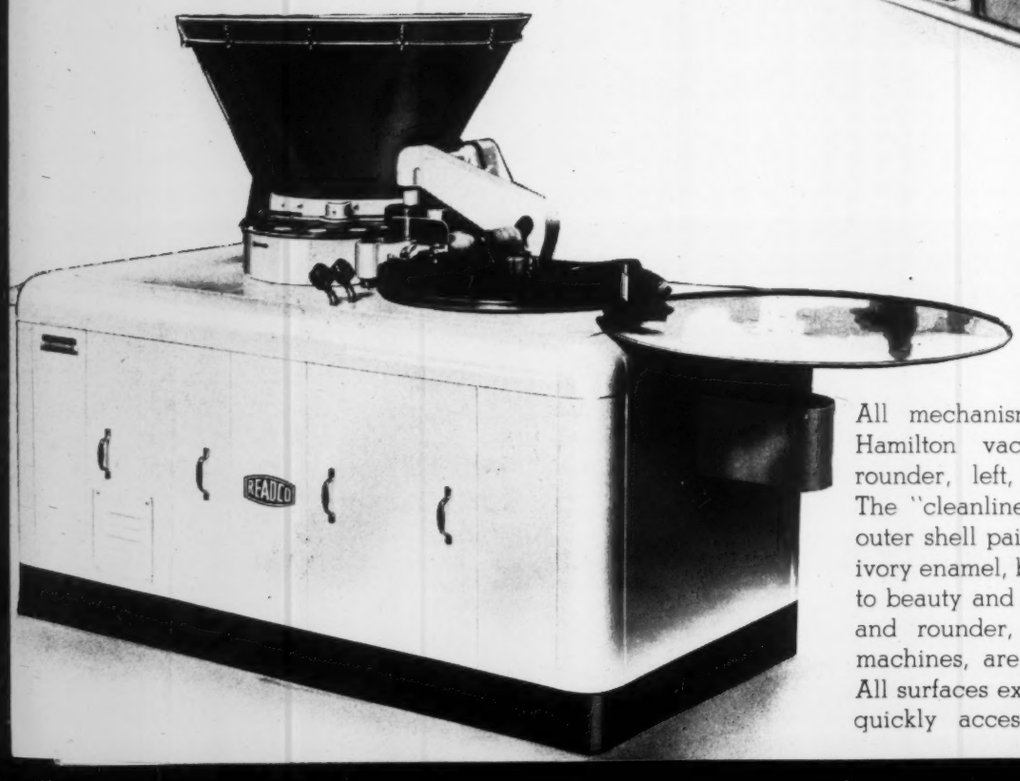


For utmost safety, all moving parts of the Hobbs die cutting press, left, are fully enclosed. When power is cut the press stops in less than a full stroke. It is operated by a built-in 3-horsepower compound reduction gear motor. Upper ends of the side rods are equipped with Oilite bushings, obviating frequent oiling. An overload protection switch with pushbutton control is conveniently located on the front

The Dazey ice crusher, left, has only two enclosing units, a die cast zinc housing with stainless steel knives within, and a tight-fitting molded Bakelite cup, held onto the body by two interior lugs. The standard model, illustrated, has a bright white enamel body and handle; the deluxe model has all exterior metal parts chromium plated. Both models were styled by Barnes & Reinecke

All working parts of the Continental band filer, right, are contained in the housing. The file band is of Swedish flexible spring steel on which are riveted short segments of special files. The machine has a gear reduction mechanism, and sealed ball bearings are used throughout. A ¼-horsepower motor mounted at the rear operates the band filer, with a V-belt conveying power





All mechanism of the Readco-Hamilton vacuum divider and rounder, left, is fully enclosed. The "cleanlined" steel frame and outer shell painted in durable old ivory enamel, black trimmed, adds to beauty and efficiency. Divider and rounder, formerly separate machines, are one compact unit. All surfaces exposed to dough are quickly accessible for cleaning

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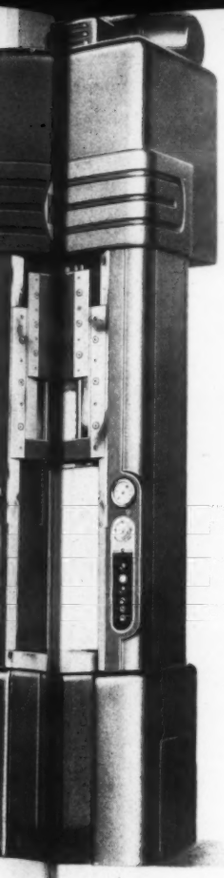
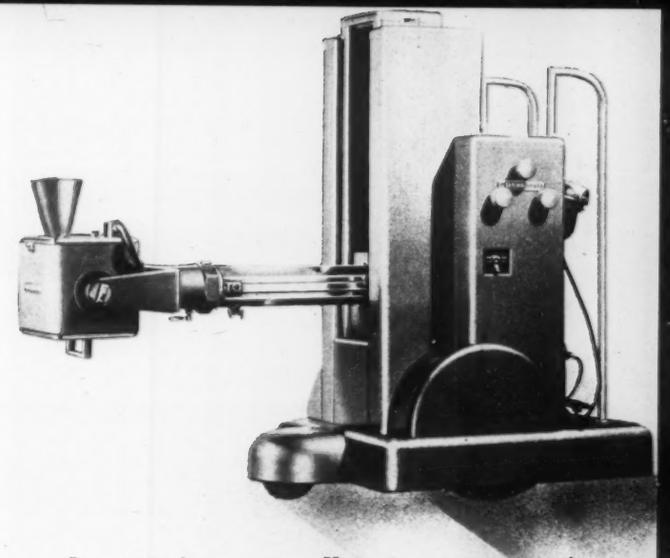
sign Features New Machines

Particular Reference to Styling

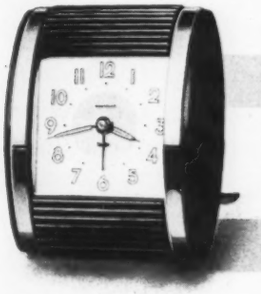


Styling of the Hydraulic Fastraverse press, left, is termed "Smooth Line," making possible a self-contained unit with built-in controls, concealed piping, and electric motor-driven radial pump mounted overhead. Notable is the application of sleek design to heavy pressure machinery, a trend apparent in other units on this page. Not only is appearance enhanced, but weight is reduced, floor space minimized. Every operating element is accessible

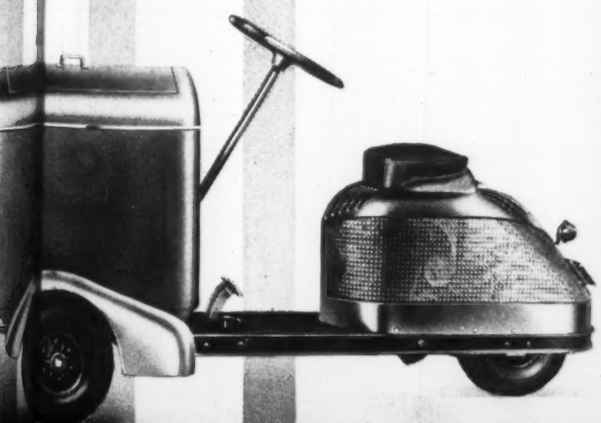


A principle new in X-ray engineering—the telescopic stand—is applied in the Westinghouse mobile X-ray, above, thus eliminating the problem of passing under overhead obstructions. The wheel base actually has knee action. Instruments are conveniently grouped, and largely built-in. The tubular, flat-sided horizontal arm moves on oversized ball and roller bearings to give 12 inches of transverse

A sliding shutter completely closes the front of the Westclox Travalarm, below, and affords protection for traveling. One key winds a single spring which operates both time and alarm mechanisms. The luminous two-tone silvered metal dial contributes to usefulness. Black composition with nickel trim is used for the case. The Travalarm has a hinged easel back



Streamlined steel housing gives the Stereotype hydraulic molding and vulcanizing press, below, a neat, efficient appearance. Heavy rolled steel side plates assure accuracy, rigidity. Use of modern electric cartridge heating units embedded in the upper and lower platens offers self-contained heating, fumeless, odorless. The lower front panel in the base can be removed to permit access to working parts



Inner frame of the Rock-Ola, left, upon which axle and drive are mounted, rides entirely independently of the double seat frame of heavy channel steel, giving a floating ride. Reverse coil spring action is an added factor. Drive is through a heavy roller chain and sprocket gear; clutch is V-belt type, pedal-controlled. The unit is powered by a 4-cycle Johnson motor, ¾ or 1-horsepower, with magneto ignition on the flywheel

Speed and Comfort Will Be Dominant in Tomorrow's Designs

SPEED of production, convenience and safety for the operator are high spots among design developments of the year. More than ever is it being recognized by machinery builders that they are expected not only to take care of problems in metals but also in mentalities. Though opinions lately have become much more favorable toward the machine than during earlier depression years, world conditions still make it desirable to emphasize the advantages of economical production of goods by machinery.

This need for higher speed means more highly stressed machine parts, bringing to the fore another development of the current year—three-dimensional photoelastic stress analysis. As pointed out elsewhere in this issue, this method will amply supplement the previous two-dimensional photoelastic observation of stresses and will have far-reaching effects in design.

Noise reduction, another factor in increased speed, has come into greater prominence during the year. The decibel scale, instituted only a few years back, now is widely accepted as the sound level standard by means of which reduction in noise is placed on a reliable scientific basis.

Many other phases of design such as the trend toward the use of the lighter metals, the application of plastics and the introduction into engineering of transparent types of these materials, the continued increase in the use of welded parts and hydraulic operation of machines come to mind as elements in the panorama of 1938 design progress. No summary would be complete, however, without reference to electrification and the building-in of motors and controls as typified in the illustrated center spread of this issue and elsewhere in the editorial articles.

If we should hazard a comment on these factors in design (particularly as to speed of operation) as well as on the current renewed activities in engineering departments, our thought would be: Designers are giving increasing consideration to the fact that the best design, now and for many years to come, is not the design that will last the longest, but one that is capable of taking care of the more speedy production schedules brought about by current business and labor conditions. Ponderous machines, even though intended for a useful production life of as much as twenty-five years, are out!

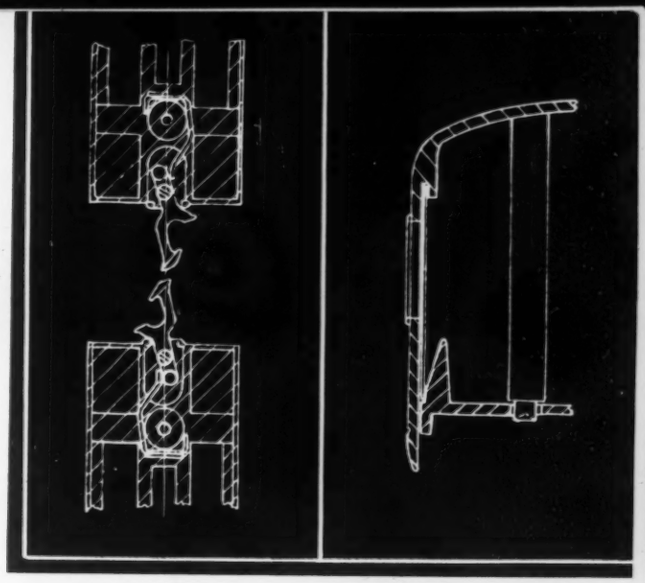


Fig. 1—Automatic couplers at left in illustration are flexible yet hold tightly. Other drawing shows section through toy train coach, revealing method of holding celluloid window and means of holding body to chassis

Design of Toys

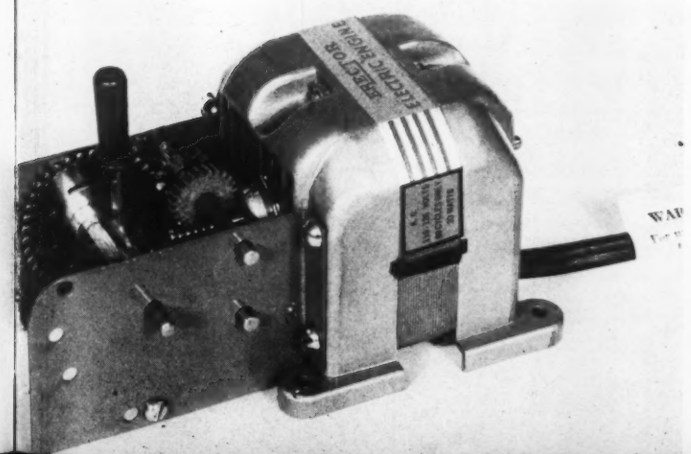
Is Not Child's Play!

PROBLEMS confronting mechanical toy manufacturers are virtually the same as those facing manufacturers of machines in practically every industry. Merchandise must be planned and consideration must be given to styling and general design. The manufacturer, moreover, must be thoroughly familiar with the many materials and devices for construction that are now available. Present-day children constitute a critical market, demanding realism and sturdiness in toys. Many principles of first-class design are incorporated in the modern gifts of Santa Claus!

Use of die castings is ever-increasing, especially for parts in construction toys which cannot be readily blanked out or cut from pinion rod. Examples are motor housings, gearboxes, gears themselves, and molds for casting sets. A single intricate casting can be made to represent an assembly of many parts or may be made to serve several functions at the same time. In addition, an aid to assembly made possible by die castings is the extensive use of hardened, self-tapping screws.

In electrical toys, however, plastics often take the place of die castings when a nonconducting material is needed. Bases for electrical devices made of molded Bakelite are a great improvement in appearance over metal bases and eliminate the necessity of insulating any part of the apparatus. In this field, Micarta frequently replaces fiber because it is less subject to atmospheric changes.

Fig. 2—Gearbox of electric engine offers great number of gear trains suitable for driving any model toy



Examples of several parts for mechanical toys will serve to indicate the design problems involved.

A unique feature of one make of miniature trains is the automatic coupler. Its peculiar shape and its position, maintained by spring tension, allows a train to back into and pick up a car on the straightaway or on a curve in a most realistic manner. The spring holds the coupler so that its hook is slightly beyond the center line of the track but is light enough so that when the couplers come together they force each other back of the center line and engage. This light tension is also necessary to prevent one car from tipping the next off the track when the train passes from a tangent into a curve. The front of the coupler has two definite angles so that as the cars are being joined the proper angle of approach will be maintained as the hook moves back toward the center line. The comparatively large space between the hook and the back of the coupler allows the train to maneuver sharp curves without danger of its cramping the head of the adjoining coupler. Flexibility of these couplers makes possible the drawing or backing of a train of cars by a locomotive through an intricate track system of reverse curves, switches, small radius curves, curves into tangents or vice versa, yet separation of the trains at any point is not possible.

In the design of a slush casting outfit which is safe and easy for a boy to operate, a number of mechanical aspects are presented. The movable half of the mold slides on two rods and is held closed by a toggle ar-

(*Concluded on Page* 74)

Men of Machines

ROY J. LECKRONE

THROUGH past experience Roy J. Leckrone, formerly with Continental Roll & Steel Foundry Co., is well qualified to handle engineering design problems of the steel and allied industry in his new position as chief designing engineer of Lewis Foundry & Machine Co.

With Morgan Engineering Co. and Central Steel & Massillon Rolling Mill Co., he obtained practical knowledge of alloy steels and steel mill machinery, which he subsequently furthered by becoming associated with E. W. Bliss Co. He later designed and developed a new three-roll type tube piercing mill, said to be the fastest of its type in the world. Returning in 1934 from a three-year contract to U.S.S.R., where he designed, built and installed American type steel mill equipment, he joined the Continental Steel & Foundry Co. and remained with that organization until his present change.

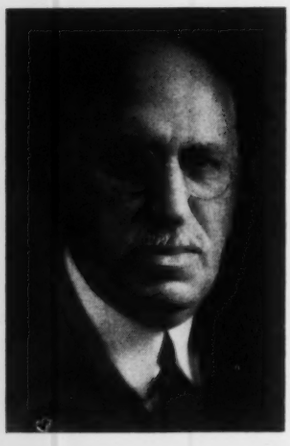
• • •

DR. H. A. CURTIS

OUTSTANDING in the field of engineering education, having served on the faculties of the University of Colorado, Northwestern university and Yale university, Dr. Harry Alfred Curtis has resigned as chief chemical engineer of the Tennessee Valley Authority to become dean of the college of engineering and director of the engineering experiment station at the University of Missouri. He is also one of the leading chemical engineering authorities, having done considerable research work along this line.

A native of Colorado, Dr. Curtis was born in Sedalia in 1884, and received his Bachelor of Science degree from the University of Colorado in 1908. His Master's degree was obtained at University of Wisconsin six years later. Dr. Curtis holds some twenty-two patents and has published numerous articles in trade and technical journals.

• • •

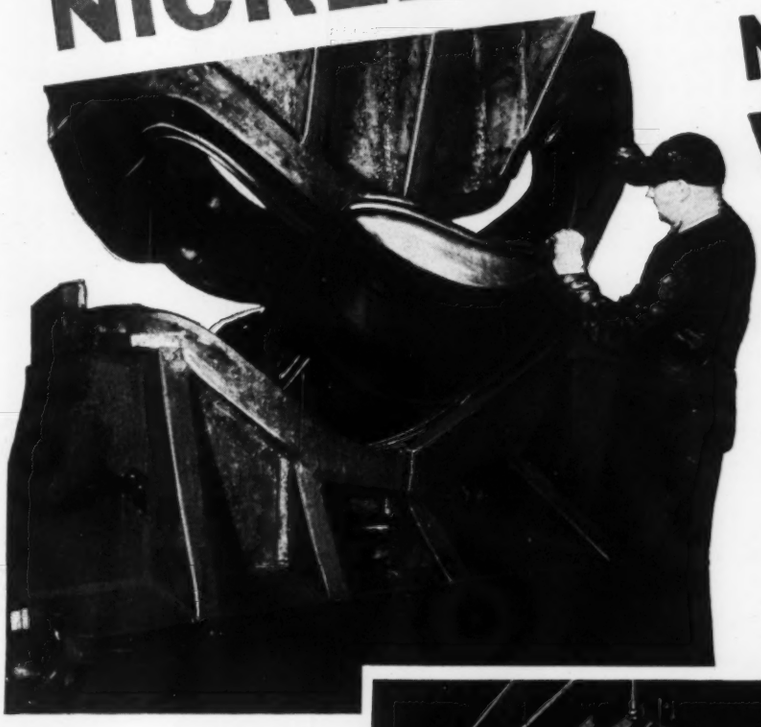


W. S. SHIPLEY

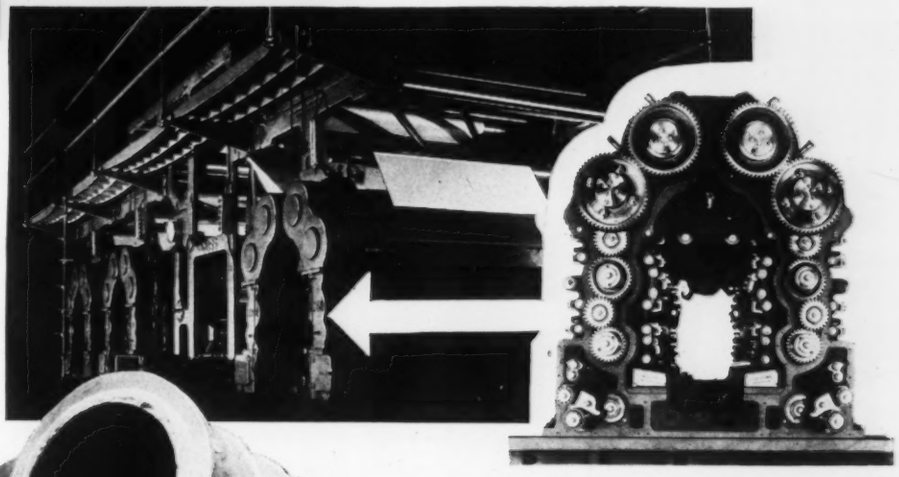
ACTIVITIES of the Refrigerating Machinery association have been placed in the capable hands of a long recognized leader in the refrigerating industry—W. S. Shipley, recently elected its president.

The business career of Mr. Shipley, born in Jersey City, N. J., dates back to 1900 when he began his service with the York Mfg. Co., York, Pa., the original name of the company of which he is now president. After two years in the factory he was promoted to erecting engineer for refrigerating machinery. Leaving this position he entered the firm of S. J. Shipley & Co. in 1904, engaging in the construction and selling of York refrigerating machinery. In 1907 he was made vice president and general manager of the newly-organized Shipley Construction & Supply Co., a position he occupied until this company was merged with the York

NICKEL *turns the oldest metals to* NEW and WIDER USES

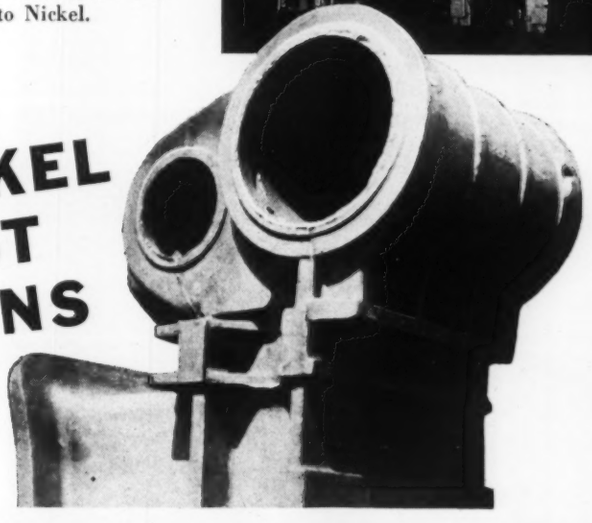


Among the metals whose commercial use dates back for centuries is cast iron . . . a material that has always been highly respected for its adaptability, machinability and low cost. Times have changed . . . so has cast iron — thanks to scientific foundry practice and the intelligent use of alloying elements — principally Nickel. Considerably stronger, harder and more wear-resistant than the unalloyed product, Nickel Cast Iron is economical for many modern applications. For example, the Nickel cast iron fender forming die pictured here is capable of stamping out more than 30,000 automobile fenders without redressing. This performance is 3 to 6 times greater than is possible with plain grey iron and results in fewer interruptions of the production schedule for regrinding operations as well as appreciable reductions in maintenance costs.



Here is a modern newspaper press manufactured by Goss of Chicago in which all the gears are made of Nickel Cast Iron. In selecting this material for this application, Goss engineers were able to take advantage of the initial economy of cast iron. In addition, they obtained gears capable of withstanding the stress and wear of high speed operation — thanks to Nickel.

NICKEL CAST IRONS



Modern railroads cannot tolerate excessive locomotive failures. For instance, in cylinders, due to the trend towards greater tractive effort at high speeds, higher boiler pressures and superheated steam with its increased cylinder temperatures, strength, density and pressure tightness are the prime requisites. That is why railroads are turning more and more to Nickel Cast Iron for this purpose and various other applications demanding these all-important properties.

Our casting specialists will be glad to consult with you and suggest where the Nickel Cast Irons will effect economies in your plant or equipment.

THE INTERNATIONAL NICKEL COMPANY, INC., NEW YORK, N.Y.

Mfg. Co. and became York Ice Machinery Corp. At that time he was named vice president and general eastern manager. He was appointed vice president in 1929 and a year later was made the company's president.

♦

CARL W. HORACK, recently a member of the faculty of University of California, has joined the Merco-Nordstrom Valve Co., Oakland, Calif., as assistant engineer.

♦

VICTOR A. HANSON, who has resigned as vice president and chief engineer of the Power Transmission Council Inc., has accepted a position with Whitney Chain Co.

♦

WILLIAM J. DAVIDSON, general sales manager of the Diesel engine division of General Motors Corp., has been appointed president of the Society of Automotive Engineers for 1939. Mr. Davidson has been with the company almost continually since serving in the Motor Transport Corps during the World war.

♦

T. G. TELBRIDGE, manager of the Research and Development department of Atlantic Refining Co., Philadelphia, has been elected president of the American Society for Testing Materials.

♦

B. J. HOSKINS has resigned from his recent position as vice president in charge of engineering of the Potter Co. Mr. Hoskins previously had been chief engineer for many years of Jos. Wiedenhoff Inc.

♦

J. W. MEADOWCROFT, assistant works manager of Edward G. Budd Mfg. Co., Philadelphia, has been presented the Samuel Wylie Miller Memorial award, given by the American Welding society. Mr. Meadowcroft, as an inventor, has contributed materially in a creative way to the advancement of welding, and has been granted some twenty-five or thirty U. S. patents and some fifty-four foreign.

♦

CHARLES H. HUGHES has resigned as research engineer and designer of Semet-Solvay Engineering Corp. to establish his own consulting engineering service at 270 Broadway, New York.

♦

J. R. TOWNSEND has been elected a member of the executive committee, American Society of Testing Materials, Mr. Townsend, who is materials standard engineer, Bell Telephone Laboratories Inc., New York, takes the place vacated by ALLEN ROGERS, recently resigned due to ill health.

♦

FRANK MALCOLM FARMER has been re-elected chairman of the Engineering Foundation, a research organization of the major national engineering societies, for 1938-39. Mr. Farmer, who enters upon his third term, is vice president and chief engineer of the Electrical Testing Laboratories, New York, and is an authority on electrical measurements, electrical insulating materials, testing of engineering materials and high voltage cables.

♦

D. ROBERT YARNALL has been re-elected president, United Engineering Trustees, New York, of which the Engineering Foundation is the research organization. Mr. Yarnall is chief engineer Yarnall-Waring Co.

♦

MAJOR GENERAL WILLIAM H. TSCHAPPAT has been elected an honorary member of American Society of Mechanical Engineers. He formerly was chief of ordnance, United States army.

♦

C. J. BOCK, engineer, General Motors Truck and Coach division, Yellow Truck & Coach Mfg. Co., was recently nominated as vice president in the truck, bus and railcar division of the Society of Automotive Engineers council for 1939. J. S. ERSKINE, engineer with International Harvester Co., was nominated as vice president of the society for the tractor and industrial power equipment division.

♦

WILLIAM C. SCHULTE has become assistant professor of mechanical engineering at Rutgers university. He was formerly with Lukens Steel Co.

♦

W. O. BATES JR. of San Francisco, at one time an executive of Bates Machine & Tractor Co., later a part of the Foote Bros. Gear & Machine Co., has been appointed manager of the patent department of Caterpillar Tractor Co. A graduate of Cornell university, Mr. Bates previously had been a consulting mechanical engineer.

♦

C. W. HANGOSKY, formerly with Carborundum Co. and Simonds Saw & Steel Co., has been appointed instructor of the department of mechanical engineering, Michigan State college, East Lansing, Mich.

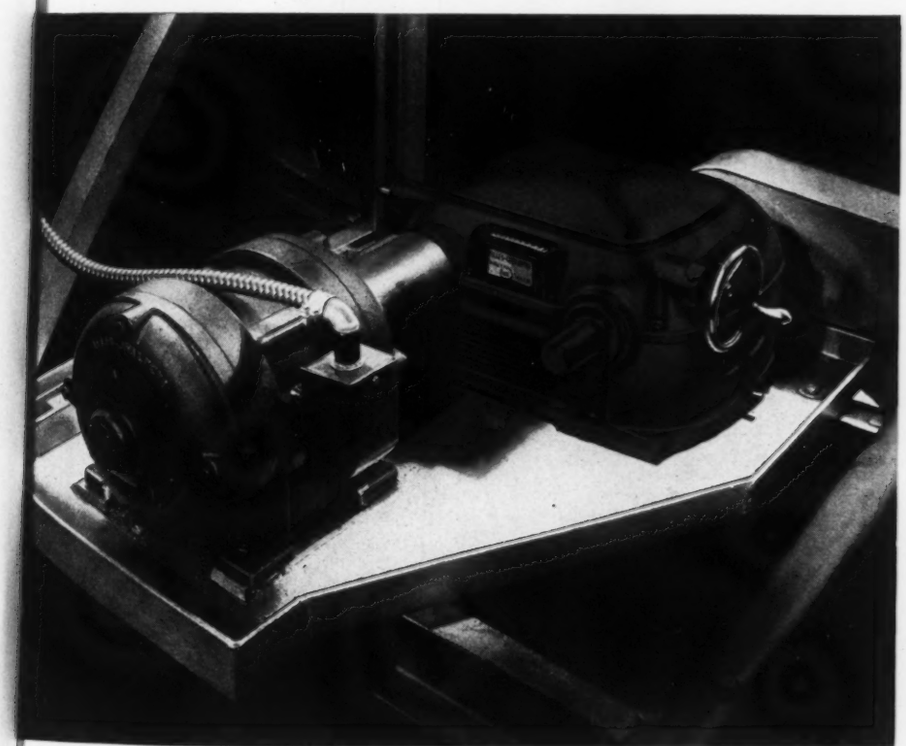
♦

FRANCIS HODGKINSON, professor at Columbia university, and consulting engineer, has been awarded the Holley medal by the American Society of Mechanical Engineers for "meritorious services in the development of the steam turbine." Other awards by the society were as follows: The Worcester Reed Warner medal to LAWFORD T. FRY, railway engineer, Edgewater Steel Co., Pittsburgh, for "written contributions relating to improved locomotive design and utilization of better materials in railway equipment"; the Melville medal to ALPHONSE I. LIPETZ, chief consulting engineer in charge of research, American Locomotive Co., Schenectady, N. Y., for his paper on "The Air Resistance of Railroad Equipment."

MAKE YOUR MACHINES BIGGER...

MONEY MAKERS

Here's How the Allis-Chalmers Vari-Pitch Speed Changer Helps Sell Your Machines . . . Gets You Bigger Profits! It's 95% Efficient . . . The Most Efficient Speed Changer On the Market Today! Read the Facts! . . .



Cutting costs on a conveyor line is this Vari-Pitch Speed Changer direct connected to an Allis-Chalmers 1150 rpm "Lo-Maintenance" Motor.

Flexible production, uniform product, waste cut to the bone—that's what your customers want. They want machines geared to modern standards . . . machines that operate in a higher speed range than ever before . . . at less cost.

And the way to sell those customers . . . to make your machines get bigger profits is with the new Allis-Chalmers Vari-Pitch Speed Changer! 95% efficient . . . built to run your machines at exactly the speed production demands . . . it can be coupled to a standard, low cost, high speed motor to make production flexible without adding expensive or bulky equipment.

No Springs, No Steps, No Guesswork!

There are no springs to get out of order, no steps that make the user take time out for adjustment, no guesswork. With the Vari-Pitch Speed Changer, smooth speed changes—that remain constant—can be made without stopping production.

Once you've equipped your machines with Vari-Pitch Speed Changers, you'll agree with transmission engineers who declare that it will revolutionize speed changing practice just as the Texrope Drive revolutionized transmission practice.

The Vari-Pitch Speed Changer is a product of Allis-Chalmers, originators of the Texrope Drive and Vari-Pitch Sheave. It is available in sizes 1 to 33 hp., ratios up to 3¾ to 1, maximum output speed, 3500 rpm. . . . Get the whole story. Send for Bulletin 1266 and see for yourself how you can increase sales and profits by equipping your machines with the new Allis-Chalmers Vari-Pitch Speed Changer.

Vari-Pitch Speed Changers • Texrope V-Belts • Duro-Brace Texsteel Sheaves • Vari-Pitch Sheaves • Standard Cast Iron Sheaves • Adjustable Pitch Diameter Texsteel Sheaves • 2-3-4 Combination Sheaves • Straitline Automatic Motor Bases • Oil Field Drilling Rigs

Belts by Goodrich

TEXROPE DIVISION

ALLIS-CHALMERS

MILWAUKEE·WISCONSIN

947

See the Point

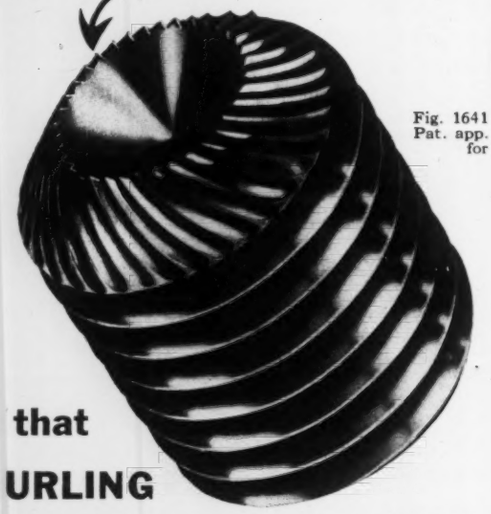


Fig. 1641 Pat. app. for

. . . that
KNURLING
POSITIVELY PREVENTS
VIBRATION FROM LOOSENING
the

UNBRAKO

SELF-LOCKING
HOLLOW SET SCREW

By merely tightening-up this new Cup Point Set Screw in the ordinary manner, it automatically locks itself in place and WILL NEVER VIBRATE LOOSE BY ITSELF. One important and outstanding advantage in the "Unbrako" Self-Locker is that it can be adjusted over and over again and will lock equally well every time. Another is the absolute lack of resistance offered by the knurling during tightening-up. These facts have been conclusively proven by countless tests made in many different industrial plants and under varied operating conditions.

Write for samples, prices and more information about the use of "Unbrako" Knurled-on-the-point Self-Locking Hollow Set Screws.

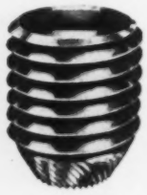


Fig. 1645

STANDARD PRESSED STEEL CO.
BRANCHES BOSTON DETROIT INDIANAPOLIS
JENKINTOWN, PENNA.
BOX 102
BRANCHES CHICAGO ST. LOUIS SAN FRANCISCO

NEW Materials and Parts

Motor Uses No Commutator

AN EFFICIENT small power motor of the permanent split capacitor type is being offered by The Ohio Electric Mfg. Co., 5917 Maurice avenue, Cleveland. It has no commutator nor internal switch. As illustrated, the motor is used for circulating water in hot water heating systems; it also can be installed on oil burners, air conditioning units and other machines not requiring excessive starting torque. Rated from 1/150 to 1/20-horsepower, depending on the capacitor employed, it has speeds of 850, 1700 or 3400 revolutions per minute. This motor delivers a starting torque of .75-ounce-foot equal to 150 per cent of full load, and a maximum running torque of 2.5-ounce-foot equal to 500 per cent of full load. It starts and operates properly in temperatures below freezing. At full load the current equals .35 amperes at 110 volts and the efficiency goes up as rated power increases. The motor can be built with solid or resilient base to operate horizontally or vertically with shaft extension up or down. Bearings are oiltight, diamond bored, and the oil wells are of ample size, felt-filled. They are designed for at least 1000 hours continuous operation per oiling.

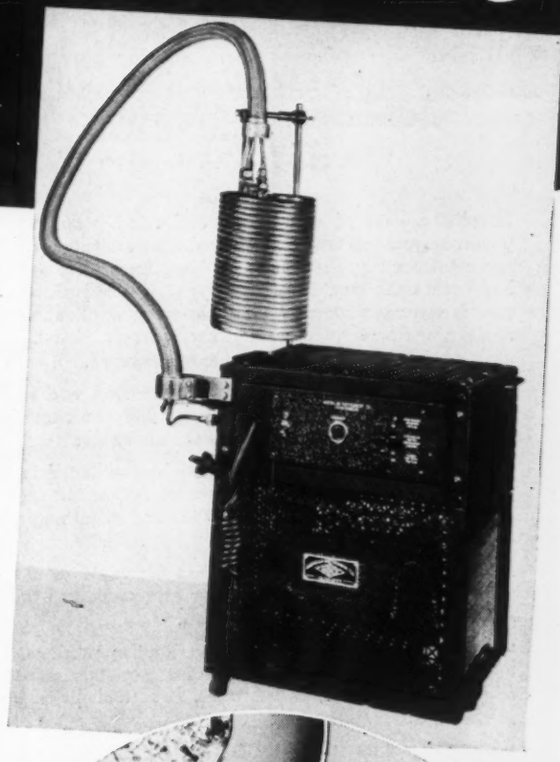
Permanent split capacitor type motor has been developed for economy and efficiency on applications not requiring excessive starting torque

Mounting Introduces New Idea

A NEW principle in the design of rubber mountings is introduced in the type 40 Vibro-Insulator announced by the B. F. Goodrich Co., Akron, O. It is known as "adjustable deflection," and enables regulation by the user to provide either a soft or stiff type mounting, according to the nature of the service. In the illustration *Fig.* 1 shows the unique construction of the Vibro-Insulator, consisting of rubber

Plant managers agree on American Flexible Metal Tubing

The modern, simplified method of connecting moving or misaligned parts, or absorbing vibration

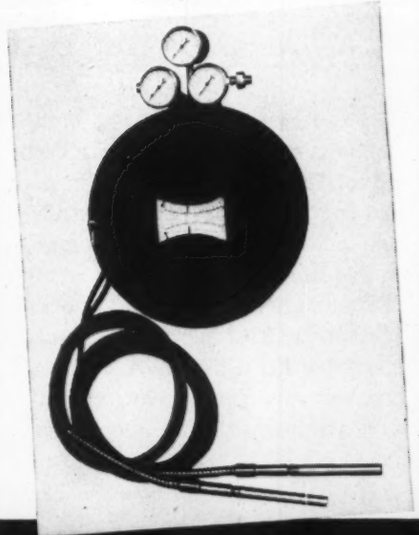


Plant managers and design engineers everywhere agree that the safest and most modern method of conveying liquids or gases to moving parts is in the use of flexible all-metal connectors. And for absorbing destructive vibration or hooking up misaligned parts—for carrying fluids, gases or semi-solids under constant or intermittent high pressures—American Seamless Flexible Metal Tubing gets the call nine times out of ten.

We have a complete line of Flexible Metal Hose and Tubing for simple and tough services alike—for use merely as a conduit cover, or for carrying high pressure steam or oil while constantly flexing.

Flexible connector problems are the specialty of our engineers. Their cooperation in studying *your* problem entails no obligation.

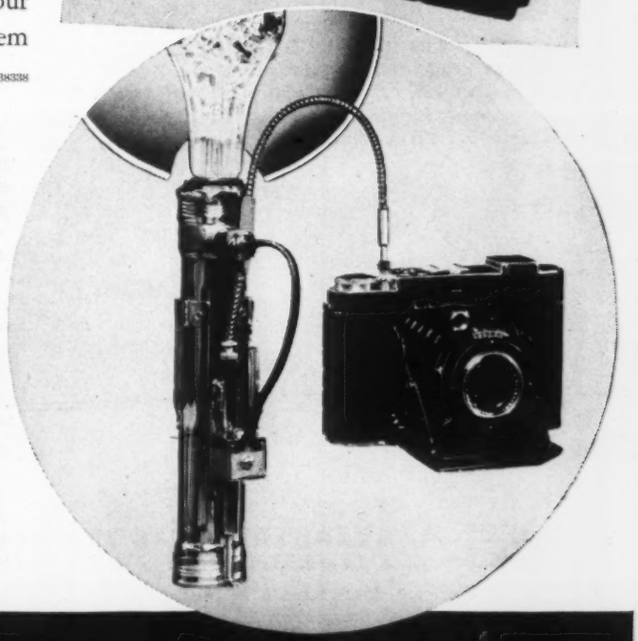
38338



An example of specially engineered flexible tubing—a duplex assembly, one flexible inside the other, for carrying the refrigerant on a cooling unit.

← Protector for the capillary tubes on recording instrument; this tubing protects delicate capillary tubes against breakage or abrasion.

Flexible chrome → plated conduit covers the shutter actuator on this camera equipment.



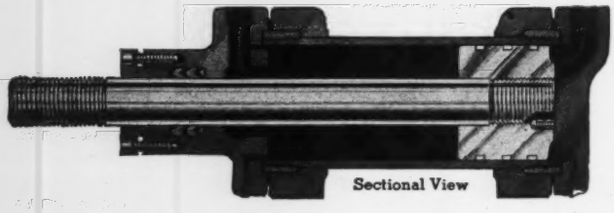
American Metal Hose

ANACONDA from mine to consumer

THE AMERICAN METAL HOSE BRANCH of THE AMERICAN BRASS COMPANY

General Offices: Waterbury, Conn. • Subsidiary of Anaconda Copper Mining Company

Hydraulic Power Advantages **plus**



Sectional View

Simplicity, ease of application, and flexible control of power movements are hydraulic cylinder advantages that are reinforced by the design of Hannifin high pressure hydraulic cylinders. Their new type, patented construction is stronger, simpler, and easier of application to modern equipment. High efficiency hydraulic power and ability to withstand severe service are assured.

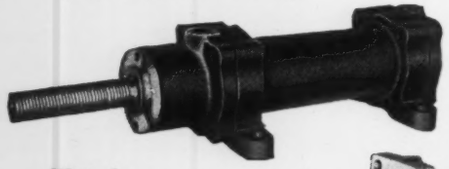
NO TIE RODS. This simpler design is stronger, and eliminates a source of leakage. End caps may be removed without collapse of other parts of the assembly.

UNIVERSAL CAPS. Either end cap may be positioned independently, so that inlet port is at top, bottom, or either side. Either cap may be moved without disturbing the cylinder mounting or other parts.

AIR VENT PLUGS. Each end cap has air vents on three sides. With the inlet port at either side or bottom there is always an air vent plug at the top.

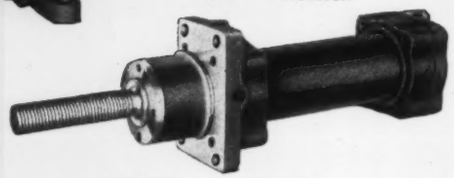
LEAK-PROOF. Special mirror finish honing produces a cylinder bore that is straight, round, perfectly smooth, and concentric with the end caps. A perfect piston seal is obtained.

MANY TYPES AND SIZES. Available in six standard mounting types, with small diameter piston rod, 2 to 1 differential piston rod, or double end piston rod, in all sizes, for working pressures up to 1000 and 1500 lbs./sq. in. Other types built to order.



Model CN

Model JN



Write for Bulletin 35-MD, with complete data.

Other Mountings Available

HANNIFIN MANUFACTURING COMPANY
621-631 South Kolmar Avenue, Chicago, Illinois
Engineers • Designers • Manufacturers
Pneumatic and Hydraulic Production Tool Equipment

HANNIFIN
HYDRAULIC CYLINDERS

vulcanized to two parallel metal disks which are drilled and tapped for a 5/16-inch steel thread. The hole extends the entire length of the mounting. Deflection is varied by the length of the attaching screws. *Fig.* 2 shows these screws penetrating nearly

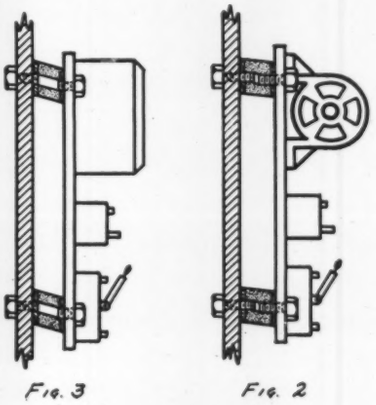


Fig. 3 *Fig. 2*

Vibro-Insulator rubber mounting can be regulated for deflection by varying length of attaching screws

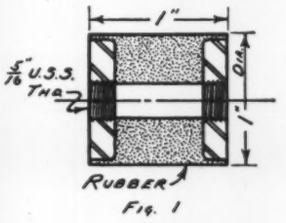


Fig. 1

to the center of the unit, to form relatively stiff, small deflection mountings. *Fig.* 3 illustrates how the full cushioning value of the Vibro-Insulator is utilized by simply attaching with short screws which penetrate only the metal disks. This mounting is furnished in only one size: 1-inch diameter, 1-inch length.

Anti-Rust Preparation Improved

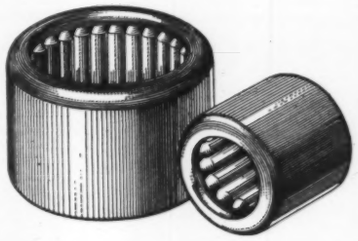
AN IMPROVED formulation of its anti-rust preparation, No-Rust Liquid V-15, has been developed by the Frost Paint & Oil Corp., Minneapolis. It is recommended for protecting polished steel parts of machinery and tools against rust in storage, and during shipment. No-Rust Liquid V-15 is easily applied with a brush or spray gun, requires no mixing or special preparation. It dries in 30 minutes to form a tough, elastic, nonporous film which resists abrasion, moisture and salt air. The protective coating is readily removed by wiping with gasoline or kerosene when the machine is placed in service.

Constant Speed Reducers Developed

A LINE of constant speed reducers has been developed by the Stephens-Adamson Mfg. Co., Aurora, Ill. Under the trade name Saco, these reducers can be used with any standard motor and are available for output speeds within the range 13.2 to 172 revolutions per minute. The motor support is adjust-

TORRINGTON NEEDLE BEARING

DESIGN AND SERVICE FEATURES

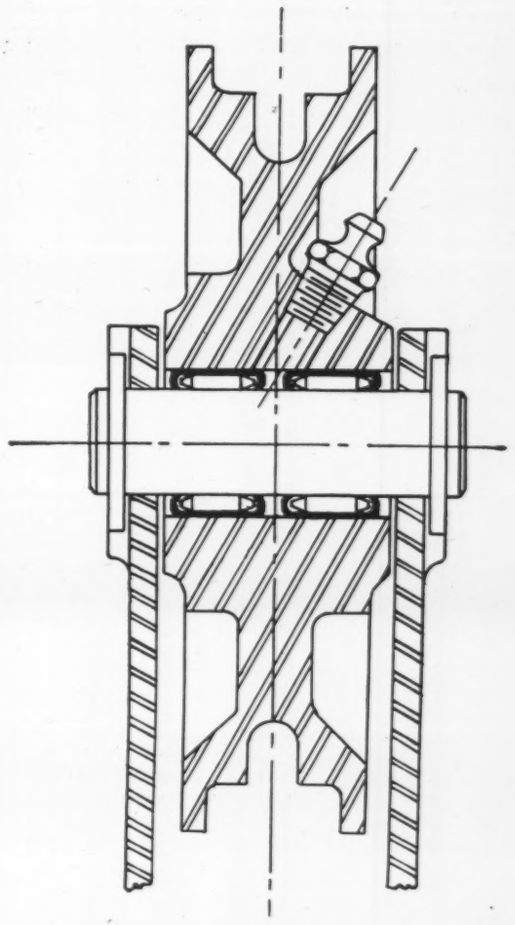


HIGH RADIAL CAPACITY FOR SEVERE SERVICE

Small Sizes Take Heavy Loads

HIGH RADIAL LOAD CAPACITY of the Torrington Needle Bearing makes it ideal for use in applications where loads are heavy. In extremely severe applications, such as the chain hoist lower sheave illustrated, extra capacity bearings with a specially hardened shaft are used to increase still further the normally high capacity of the Needle Bearing. The many linear inches of contact provided by the bearing's full complement of small-diameter needles permit the use of relatively small bearings.

The turned-in lips of the hardened retaining shell hold a large supply of lubricant, and reduce the frequency with which service attention is needed. Grease fittings may be used to simplify periodic renewal of the lubricant.



TYPICAL ILLUSTRATION OF TORRINGTON NEEDLE BEARINGS OF EXTRA CAPACITY IN SEVERE CHAIN HOIST SERVICE.

Low Unit Cost

The Needle Bearing, offering the advantages of complete anti-friction construction, is comparable in overall cost with the use of simple bushings. The bearing itself is remarkably low in unit cost, and can be assembled in place quickly and inexpensively. The shape of the bearing — small radially and long axially — greatly simplifies the type of housing construction needed; a bore of the right diameter serves to mount the bearing. The bearing's unit construction, with its needles held by the hardened retaining shell, makes it very easy to assemble in the housing.

In considering the use of Needle Bearings, manufacturers are invited to avail themselves of the experience of the Torrington Engineering Department in laying out bearing applications. Further information is contained in the Torrington Needle Bearing Catalog, available on request. Write for Catalog No. 9.

The Torrington Company
ESTABLISHED 1866
Torrington, Conn., U.S.A.
Makers of Ball and Needle Bearings
Branch Offices in all Principal Cities

TORRINGTON
NEEDLE BEARING

Accurate, uniform lettering—done with speed and ease—that is Leroy's contribution to the finished appearance of your drawings.

A Leroy set consists of patented templates, a simple scriber and foolproof, tubular pens. Each template produces both vertical and slanting letters and numerals. Complete, finished letters are formed in one operation. No guide lines, no preliminary roughing in. The work is performed well above the template, in full view of the operator; there is no danger of smearing when the template is removed.

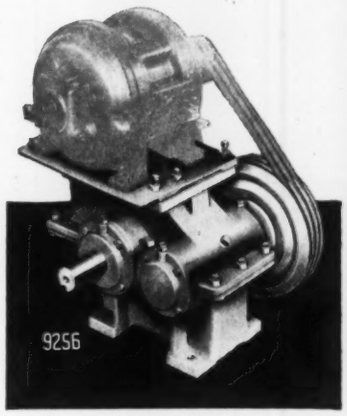
There are templates and pens of all sizes—sold singly or in sets. You make your selection to fit your own standards and requirements. Prices are moderate.

Add Leroy lettering to your drafting room equipment. Your K & E dealer will be glad to arrange a demonstration—or write us for Booklet No. 42 and price list.

K & E LEROY
REG. U.S. PAT. OFF.
LETTERING SETS

EST. 1867 **KEUFFEL & ESSER CO.**
NEW YORK · HOBOKEN, N.J.
CHICAGO · ST. LOUIS · SAN FRANCISCO · DETROIT · MONTREAL

able for V-belt drive, permitting sheaves to be replaced or changed if desired. Heavy overhung load is permitted by the shaft support construction, and



Constant speed reducers just announced can be used with any standard, full speed motor to give required output speed

all shafts are mounted in precision ball bearings with the helical steel gears operating in a constant bath of oil.

Clutch Uses Floating Rolls

USING tapered hardened steel rolls that are free to float in two directions, a new clutch is announced by Ramsey Chain Co. Inc., Albany, N. Y. The rolls when forced into engagement, do not grip instantly, but are retarded just enough to relieve the

Tapered rolls in new clutch do not grip instantly when forced into engagement, but are retarded just enough to relieve motor from sudden shock load

motor, or other prime mover, from the sudden shock load. The clutch can be engaged or disengaged at will, and is 100 per cent positive when engaged. It will operate in either direction and can be driven from either end.

Rivet Developed for Blind Side Work

DEVELOPED for use in places where there is a blind side, that is, where only work from the outside is practicable, a new pull rivet is announced by Hopkan Rivet Co., 128 Latham street, Pittsburgh. It requires no hammering, riveting or backing plate. The rivet can be used for assembling fine thicknesses of sheet metals, as well as for fastening woven materials to wooden or metal frames. The male has a shank with a groove in it for pulling purposes, and is pulled through the slotted female

SHAFER

concave

ROLLER DESIGN

provides an automatic compensation for misalignment up to 1½ degrees either side of center. Load bearing capacity and the free-rolling bearing action are maintained unchanged. Severe service conditions are easily met, and installation frequently simplified when full advantage is taken of this Shafer feature.

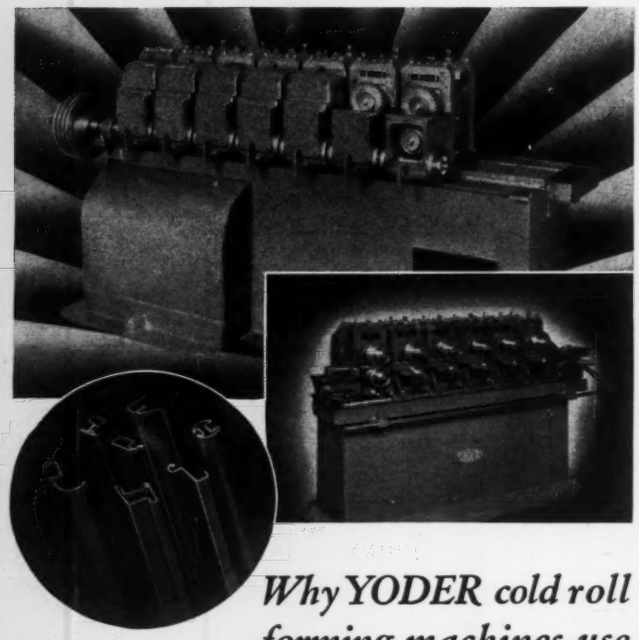
Only Shafer combines 1. Integral self-alignment, 2. Capacity for radial, thrust, or combined radial-thrust loads, 3. Simple adjustability.

Available in a full range of sizes: Pillow Blocks · Flange Units · Take-up Units · Cartridge Units · Hanger Boxes · Flange-Cartridge Units · Duplex Units · Conveyor Rolls · Radial-thrust Roller Bearings.

Write for Catalog 14 with complete information.

SHAFER BEARING CORPORATION
35 East Wacker Drive • Chicago, Illinois

SHAFER SELF-ALIGNING ROLLER BEARINGS



Why YODER cold roll forming machines use

OHIO GEARS

Perfect uniformity of product . . . precision of cut . . . smooth operation . . . speed to suit demands . . . long life . . . those are but a few of the specifications which all Yoder Cold Roll Forming Machines must meet. So Yoder Engineers check and recheck each part. They know, for instance, the responsibility placed on the power transmission. So, in their selections, they choose gears they know will help them meet those specifications. They look too, for another factor—*quick, reliable service* from the gear cutter.

That's why Ohio Cut Gears are standard on so many machines bearing the famed Yoder trade-mark.

You too, may find Ohio Gears a profitable answer to a gear problem. Whether you design or maintain machinery, you'll find their advantages well worthwhile. Investigate Ohio Gears, (stock or special,) Ohio Speed Reducers and Power Transmission Equipment for your own needs. Write today.

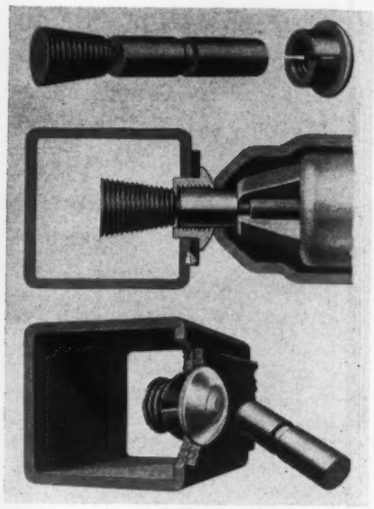
THE OHIO GEAR CO.
1338 E. 179th Street • Cleveland, Ohio

Representatives

*Los Angeles, Calif. J. W. Minder Chain & Gear Co., 927 Santa Fe Avenue.
*San Francisco, Calif. Adam-Hill Co., 244-246 Ninth Street.
Indianapolis, Ind. A. R. Young, 518 North Delaware Street.
Louisville, Ky. Alfred Halliday, 330 Starks Building.
Detroit, Mich. George P. Coulter, 322 Curtiss Building.
Madison, Wisconsin. M. Ratclif, Shorewood Hills.
Buffalo, N. Y. F. E. Allen, Inc., 2665 Main Street.
New York City, N. Y. Patron Millwright & Transmission Co., 154-156 Grand Street.
New York City, N. Y. E. G. Long Co., 50 Church Street.
Grand Rapids, Mich. W. H. Slaughter, 419 Oakdale St., S. E.
New England. George G. Pragst, 260 Esten Ave., Pawtucket, R. I.
Pittsburgh, Pa. Industrial Sales & Engineering Co., Box 8606, Wilkinsburg, Pa.
Salt Lake City, Utah. A. O. Gates, 619-629 South Fifth West Street.
*Stocks carried.

OHIO GEARS

part. The puller (any standard type) holds the parts in position while the inner section of the rivet is pulled into place, after which the shank automatically drops off. Available in any size, with

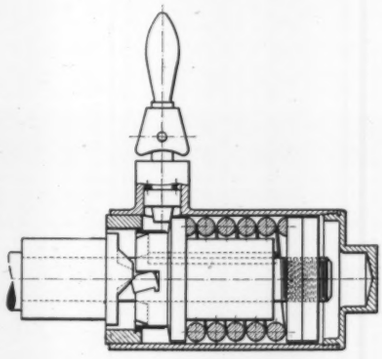


Rivet designed especially for work from the outside is available in any size, in a variety of materials

button, flat or hexagon heads, the rivet can be made from any type of sheet material, aluminum, brass, or other durable alloys.

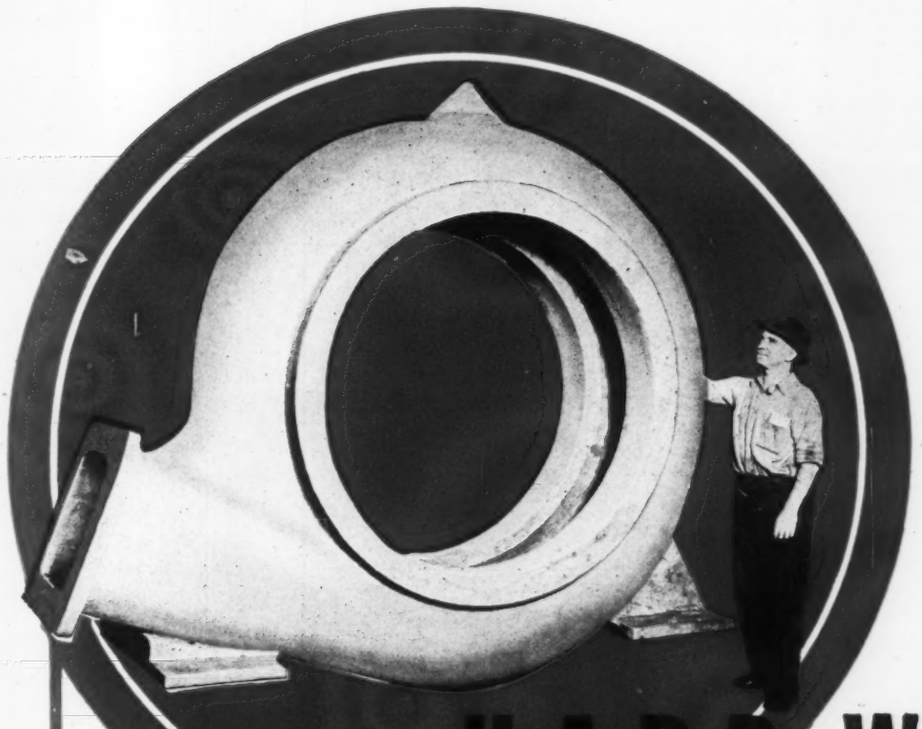
Clutch Releases at Overload

A NEW overload release clutch has been placed on the market by the Overload Release Clutch Co., 608 South Dearborn street, Chicago. Differing from type C (circumferential disengagement), the new type L disengages laterally at a predetermined load as soon as the overload occurs. It remains completely disengaged until the cause of overload has been removed and the clutch reset for operation. In the illustration the sliding bushing is held in driving position by a spring of predetermined



Clutch disengages laterally as soon as overload passes a predetermined point, remains disengaged until overload is removed

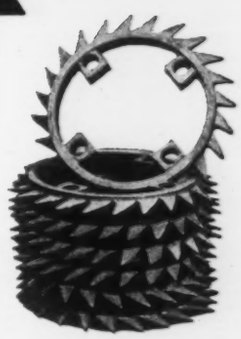
load. When an overload occurs, this bushing is forced back along the shaft. As the bushing encounters the master lug, it is kicked back far enough to permit the lockout pin to drop down against the face of the bushing. A clearance is left between the driving and driven unit, allowing coasting without friction or wear. These clutches are usually in-



For HARD WEAR— Specify CASTINGS of METAL MEEHANITE

The alloy steel shell of the big sand pump was cut to shreds in about two weeks by abrasive action. So they adopted MEEHANITE, and now get five to six months' use. Grinding gears, wear plates, liners, crusher rolls, pulverizing hammers—in scores of such uses MEEHANITE greatly outlasts manganese steel, and gray iron many times over.

In small and intricate castings as well as those of great size, the strength, abrasion resistance, corrosion resistance, and other qualities of MEEHANITE lower replacement costs. For specification data, address any of the licensed manufacturers listed below, or Meehanite Research Institute, Vandergrift Building, Pittsburgh, Pa.



COKE PRICKER RINGS
Strong, Tough, Long Wearing

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American Laundry Machinery Co. . . . . Rochester, N. Y.
Atlas Foundry Co. . . . . Detroit, Mich.
Banner Iron Works . . . . . St. Louis, Mo.
Barnett Foundry & Machine Co. . . . . Irvington, N. J.
H. W. Butterworth & Sons Co. . . . . Bethayres, Pa.
Cincinnati Grinders Incorporated . . . . Cincinnati, Ohio
The Cincinnati Milling Machine Co. . . . Cincinnati, Ohio
Cooper-Bessemer Corporation . . . . . Mt. Vernon, Ohio
M. H. Detrick Co. . . . . Peoria, Ill., Newark, N. J.
Farrel Birmingham Co. . . . . Ansonia, Conn.
Florence Pipe Foundry & Machine Co.
(R. D. Wood Company, Philadelphia, Selling Agents)
Fulton Foundry & Machine Co. . . . . Cleveland, Ohio
General Foundry & Mfg. Company . . . . . Flint, Mich.
Greenlee Foundry Company . . . . . Chicago, Ill.
Hamilton Foundry & Machine Co. . . . . Hamilton, Ohio
Kanawha Manufacturing Co. . . . . Charleston, W. Va.
Kinney Iron Works . . . . . Los Angeles, Calif.
Koehring Company . . . . . Milwaukee, Wis.
E. Long, Ltd. . . . . Orillia, Canada
Rosedale Foundry & Machine Co. . . . . Pittsburgh, Pa.
Ross-Meehan Foundries . . . . . Chattanooga, Tenn.
The Stearns-Roger Mfg. Co. . . . . Denver, Colo.
Vulcan Foundry Company . . . . . Oakland, Calif.
Warren Foundry & Pipe Corp. . . . . Phillipsburg, N. J.
Washington Iron Works . . . . . Seattle, Washington
Australian Meehanite Metal Co., Ltd., Waterloo, N. S. W.
The International Meehanite Metal Co., Ltd. . London
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"I'M NOT THE NERVOUS TYPE"

"I can stand the screech of brakes or the wail of a backfence cat. But brother, when a gritty pencil scratches my drawing I am a prospect for a padded cell. I advise all pencil craftsmen to follow my lead and switch to 'Castell'."

All gritty substance is removed from "Castell" graphite. No hard spots. No flaking, smudging or crumbling. Milled by the protected microlette process, "Castell" graphite has a flowing smoothness and richness of deep black found in no other pencil. "Castell" withstands extra hard pressure without snapping off at the point.

These—and many more—are the reasons why pencil craftsmen are glad to pay twice as much for "Castell" as for ordinary drawing pencils. 18 accurate degrees—7B to 9H. A. W. FABER, INC., NEWARK, NEW JERSEY.

THE HIGHEST PRICED DRAWING PENCIL SOLD IN AMERICA

A.W. FABER-CASTELL

DRAWING PENCIL IN THE METAL BOX

★ 15¢ 1.50 per doz.

stalled at the point of peak torque, and can be set to very close limits. They are adaptable to all types of machinery.

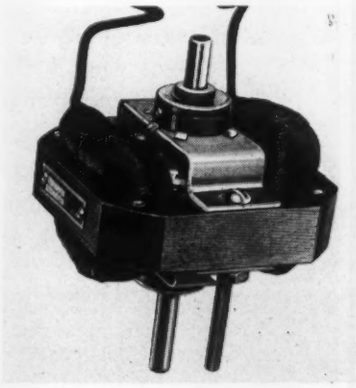
Worm Reducer Carries Heavy Load

THE Radicon worm gear reducer, developed by David Brown & Sons, Huddersfield, England, is now being distributed in the United States by Thomas Prosser & Son, 120 Wall street, New York. Safe rating of the Radicon reducer is so greatly increased that a reduction in size of the unit is possible for any given duty. Automatic oil circulation eliminates need for attention and maintenance costs. Efficient cooling, employing radiation, convection and conduction methods, is the dominant factor in the increase in load-carrying capacity of the Radicon reducer. The shape of gear tooth, in conjunction with cooling methods, insures that higher powers are possible with normal temperature rise.

Efficient cooling, employing three methods, is principal reason for increase in load carrying capacity in worm gear reducer, permitting 30 *per cent size reduction*

Four-Pole Motor Developed

WITH an idling speed of approximately 1700 revolutions per minute, a new shaded four-pole motor, the type 800, has been developed by the Electric Motor Corp., Racine, Wis. It is available either in the skeleton type as illustrated, or encased, depending on the application. It develops around 1/100-horsepower. The motor can be used in conjunction with

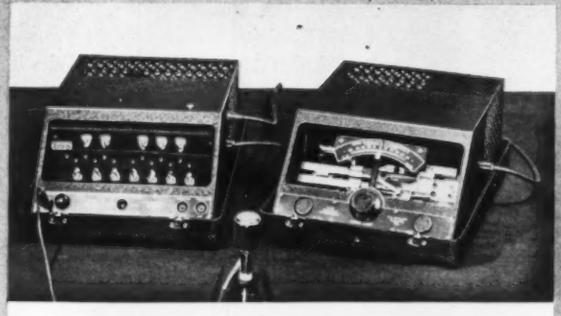


Shaded four-pole motor comes in skeleton type or encased, develops approximately 1/100-*horsepower*

(*Continued on Page* 62)

Measuring the pitch of a clarinet with the Conn Chromatic Stroboscope, driven by a Bodine motor.

This new "Electric Ear" required a motor that was COMPACT, QUIET, CONSTANT in SPEED



NEW INSTRUMENT MEASURES MUSICAL FREQUENCY

This new device, the Conn Chromatic Stroboscope, accurately measures the frequency of a tone and indicates its deviation from standard. It is used for tuning pianos, organs, and other musical instruments.

Bodine flanged type motor similar to the one used in the new Conn Chromatic Stroboscope.

For its new portable Chromatic Stroboscope, C. G. Conn, Ltd., needed a motor that was small, light in weight, quiet and free from vibration, and absolutely constant in speed. This motor had to handle sizeable loads and had to have a flanged end shield.

C. G. CONN, LTD., FOUND THESE QUALITIES IN A BODINE SYNCHRONOUS MOTOR

The Bodine 1/150 hp capacitor start-and-run synchronous motor fulfilled all these requirements. Furthermore, Bodine provided special mounting of the condenser, oil cups, and other parts. As a result, this Bodine motor was selected as standard equipment.

The Bodine line includes motors of *all* types, from 1/2000 to 1/6 hp. These motors are reliable, smooth-running, quiet, and long lived. Bodine has specialized in adapting these standard motors to individual requirements. Let Bodine solve your motor problems.

WRITE FOR BULLETIN!

BODINE

BODINE
FRACTIONAL H-P
MOTORS
ENGINEERED FOR YOUR PRODUCT

Bodine Electric Company
2258 W. Ohio St., Chicago, Ill
Please send bulletin describing Bodine motors.

Name .....

Company ..... Title .....

Address .....

City ..... State .....

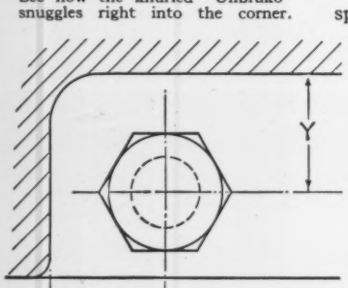
Most Designers say "KNURLED UNBRAKO SOCKET HEAD CAP SCREWS give a better appearance to the finished product"

Fig. 1434 Pats. Pend.

These cap screws with their distinctive "Unbrako" heads really dress-up any piece of equipment on which they are used. This is not our "say-so" only, but the unbiased opinion of a number of engineers and designers in varied lines of industry. Write us for a sample. You'll quickly see why this is true.

It often fits where a hex head won't

See how the knurled "Unbrako" snuggles right into the corner.



Notice the great open spaces necessary for the hex-head and wrench.

Many times, no doubt, you've had the problem of getting a screw into a tight spot, where there just wasn't enough room to apply an ordinary hex wrench. That is where "Unbrakos" can help you out. Their special wrench can be slipped into almost unbelievably small apertures and thus easily solve what would otherwise be a tough problem. See the plan views at the left. Let us tell you exactly how "Unbrako" can fit in with your needs. Write for the details.

STANDARD PRESSED STEEL CO.

BRANCHES BOSTON DETROIT INDIANAPOLIS

JENKINTOWN, PENNA.

Box 102

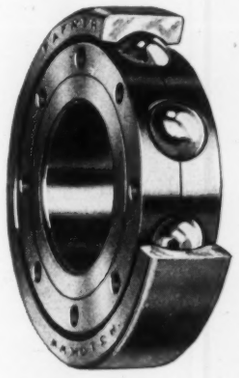
BRANCHES CHICAGO ST. LOUIS SAN FRANCISCO

(*Continued from Page* 58)

eight gear units, either spur or worm, manufactured by the company.

Bearings Eliminate Radial Chatter

TWO types of high speed ball bearings for woodworking machinery have been announced by The Fafnir Bearing Co., New Britain, Conn. Type WW, illustrated, has a machined bronze retainer; duplex type pairs have composition retainers. The combination in these antifriction bearings of large balls and deep races makes for high load capacity

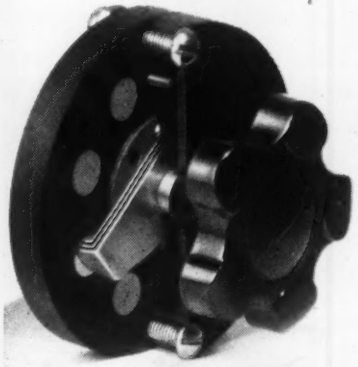


The type WW ball bearing for woodworking machinery, one of two new types just announced which combine large balls and deep races for high load capacity and shock resistance

and shock resistance. Spindles may be kept rigidly aligned, eliminating vibration and chatter on the finished work. With the accurate preload characteristics of the duplex type, a pair may be mounted at each end of a spindle to eliminate radial chatter completely, and carry a load equivalent to a much larger single bearing.

Current Control Switch Announced

FULLY enclosed, a rotary type current control switch with a capacity of 30 amperes is announced by the Kneisley Electric Co., 16 South St. Clair street, Toledo, O. All output current regula-



Contact burning is largely obviated in this rotary type current control switch through its fully enclosed construction, which excludes oxygen

tion is controlled by one insulated control handle of Bakelite construction. This is said to result in simplified operation and to assure perfect balance

ZINC ALLOY DIE CASTINGS

ECONOMY
Does Not Always Rule

The terms "die casting" and "low cost" are closely associated by every alert engineer. This economy angle is so often present that the many other fine qualities of the process may not receive their just recognition. Consider, then, the design history of this ZINC Alloy Die Cast flashlight reflector:

1. ACCURACY—The reflector has a fixed focus—requiring a *true* parabolic reflecting surface. The accuracy of the die casting process easily secures this critical requirement.

2. RIGIDITY—Only as a die casting can the reflector remain identical in contour from the forming operation to the completed flashlight assembly—and stay that way in service. A material with less rigidity would be subject to alteration in shape by subsequent polishing and assembling.

3. EASE OF ASSEMBLY—By any other production method the reflector—in its present superior design—would have to be made in two parts. Die casting permitted one part—of true parabolic reflecting surface—the solid screw base being cast integrally with the reflector bowl.

Here we find that ZINC Alloy Die Castings led the competitive field in an important product design—with little emphasis on their strongest sales asset "economy". Any commercial die caster will be glad to discuss ZINC Alloy Die Castings and their possible application in *your* products—or write to this Company.

THE NEW JERSEY ZINC COMPANY
160 Front Street New York

The Research was done, the Alloys were developed, and most Die Castings are specified with

HORSE HEAD SPECIAL (99.99+% UNIFORM QUALITY) ZINC

A BRISTO SOCKET SCREW

sets Faster... Easier...Tighter

...Another Feature of its Sound, Widely-Approved MULTIPLE SPLINE DESIGN

In assembling your products, this means

... Faster Assembly... No Waste Motion... Lower Production Costs

Thanks to its multiple spline design in the socket head, into which the Bristo wrench locks tight, a Bristo Screw will not round out, split, strip or shear. You save assembly time. Even the smallest sizes take a tighter set than is possible with ordinary screws, without the wrench skidding. No waste motion.

Bristo Screws help lower production costs in the manufacture of such products as electric shavers, sewing machines, X-ray machines, tabulating and computing machines, stock market tickers, cameras, postage meters, scientific instruments, and vending machines. Write for Bulletin 83-5N.

Electric shavers and many other products assembled faster with Bristo Screws.

MULTIPLE SPLINE SOCKET BRISTO SET & CAP SCREWS

Approved by Amer. Standards Assoc. and Amer. Soc. of Tool Engineers.

THE BRISTOL COMPANY, *Mill Supply Division*
WATERBURY, CONNECTICUT

BRISTO

TRADE MARK REG. U. S. PAT. OFF.

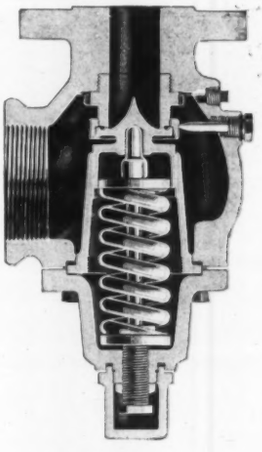
Multiple Spline

SET AND CAP SCREWS

in all three phases. The ½-inch brass contacts are molded into non-carbonizing composition, capable of withstanding 30,000 volts per inch thickness. Possibility of contact burning is claimed to be reduced greatly through exclusion of oxygen by the enclosed construction. Two models are offered: The single unit type, 4-inch outside diameter, overall length from front of knob to back cover of switch, 2¼ inches; the ganged type, 4-inch outside diameter, overall length, 5¼ inches.

Top Guided Relief Valve Announced

THE model WTN relief valve announced by the J. E. Lonergan Co., Philadelphia, has a full throat tube seat area which will induce high capacity and cause no restriction of the flow. The disk is top guided and the spring encased, placing it out of the flow of steam or hot liquids. Working parts of the valve are of symmetrical design, calculated to allow even expansion and contraction through uniform heat transfer from one working part to another, thus relieving abrasive or tearing action across the seat caused by uneven expansion and contraction of the surfaces. The WTN valve can be manufactured from any metals suitable for its intended service. It is furnished with flanged inlet and outlet, flanged inlet and screwed outlet or screwed inlet and outlet.



Disk of new safety valve is top guided and the spring is encased, placing it out of flow of steam or hot liquids

Coupling Allows Wide Displacement

EFFICIENCY of the new Wood flexible coupling announced by The Shallcross Co., Philadelphia, is not impaired by parallel or lateral displacement of shafts up to .0625-inch. Neither coupling nor bearing is affected by angular displacement of at least 10 degrees. The center section, reversible, can be obtained with driving members of fiber, hardened steel, or with load cushions of hardened steel, canvas Bakelite or wear-resisting tire stock rubber. Neoprene is obtainable on special order. There are

You, too, Can Save Time!

. order these Boston Ratiomotors* from stock!

The above photograph shows the six different sizes of Boston Gear standard Ratiomotors — 54 various output speeds in 8 power sizes ranging from 1/20 to 3 horsepower — always in stock ready for your immediate use. Our general catalog #52 contains complete specifications and list prices of all these units, so if you order any Ratiomotor listed in this publication you know you will save time — because it will be in stock ready to be on its way to you.

Send for your free copy of our General Catalog #52 containing specifications and list prices of all Boston Gear Ratiomotors carried in stock.

*Trade Mark Reg. U.S. Pat. Off.

BOSTON GEAR WORKS, INC.
NORTH QUINCY, MASS.

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Please send me _____ copies of your General Catalog #52.

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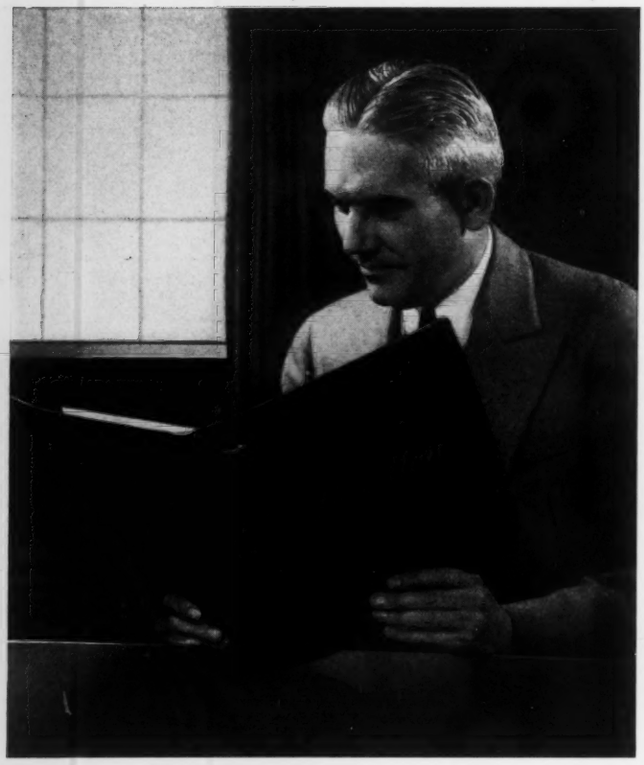


Well, that IS interesting!

● This executive is interested in the photograph portfolio a Lewellen representative has opened on his desk. His engineering experience gives him a genuine appreciation of Lewellen's leadership in the unusual applications of variable speed control.

His problem, like yours, is that of improving his product and reducing unit costs. He knows that efficient, regulated speed control of production machines is a necessity.

Perhaps your production problem that concerns the correct application of speed control is a simple one. If so, a standard Lewellen Transmission is the answer. Whether your problem is simple or difficult, you'll not be obligated for the special advice and counsel of Lewellen engineers.

Call a Lewellen Representative or Write Us NOW!
LEWELLEN MANUFACTURING CO., COLUMBUS, INDIANA

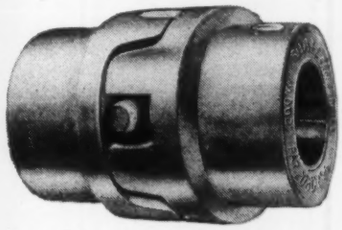
Lewellen knows speed control

•

LEWELLEN

Variable Speed **TRANSMISSIONS**

no solid contacts, since Wood couplings drive through the floating, insulated center members. Suitable for high speeds, the coupling is not affected by heats up to 300 degrees Fahr.



Flexible coupling operates efficiently even with parallel or lateral displacement of shafts up to .0625-inch, angular displacement up to 10 degrees

Engineering Department Equipment

Continuous Blueprinting Machine

SHAW BLUE PRINT MACHINE CO. INC., 9 Campbell street, Newark, N. J., has introduced the model M 42 continuous printer with washing, potashing, and drying attachment. All types of blueprints up to 42 inches in width, on paper or cloth, may be reproduced on this machine. A standard constant speed motor, with a variable speed pulley and a gear reduction unit that runs in oil, provide an infinite speed selectivity over a range of speeds from nine inches to 12 lineal feet per minute. A new type plate glass allows 20 per cent more of the actinic rays from arc lamps to pass through to sensitized paper. Potash is applied uniformly without use of spray and pump by a new "no-waste" method. Wringer rollers remove surface water from prints before they enter the dryer, hence less heat is needed to dry prints properly.

Meetings and Expositions

Dec. 5-9—

National Association of Manufacturers. Congress of American industry to be held in New York. Additional information can be obtained from Noel Sargent, 14 West Forty-ninth street, New York.

Dec. 5-9—

American Society of Mechanical Engineers. Annual meeting, technical and business sessions to be held in New York. C. E. Davies, 29 West Thirty-ninth street, New York, is secretary.

Dec. 5-10—

National Exposition of Power and Mechanical Engineering. Held at Grand Central palace, New York.

BRING *THAT SPECIAL* SPRING PROBLEM TO US

WHEN you need springs of special design . . . when you are troubled with spring fatigue . . . whenever you face spring problems in your own production — call on us. We have a staff of engineers who have at their fingertips the best of spring-making facilities, plus experience built by more than a hundred years in the making of wire products.

We can make springs to suit your special design. And regular types, too, of the highest quality. Springs made by the American Steel & Wire Company are made exactly to specifications. You can rely on them to stand up under the service for which they are intended. From the tiniest helical spring to the heavy coil spring, they are made with complete care. Our springs are all checked carefully for correctness of metallurgical and physical characteristics.

AMERICAN *Quality* SPRINGS

So often the difference between success and failure of a manufactured product depends on the springs. Let us help you get the right design for your springs. Then let us show you how we can produce those springs *exactly* as specified—correct for your own particular spring needs. A call or a letter will bring one of our engineers to help you work out your spring problems.

AMERICAN STEEL & WIRE COMPANY

Cleveland, Chicago and New York

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

NO PLACE FOR LEAKAGE HERE

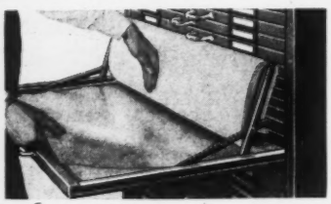
No leakage worries with Tuthill Small Pumps. Our engineers pioneered the leakproof pump and today's models are protected by the finest mechanical seal Tuthill ever built. Small pumps available for every purpose, capacities from 1/3 to 3 g.p.m. Pressures up to 400 lbs. per sq. in. Wide variety of mountings.

Write for SMALL PUMP CATALOG TODAY

TUTHILL PUMP COMPANY
941 East 95th Street • Chicago, Illinois

SPEEDIER FILING . . .

without tearing sheets



The Calumet System eliminates strain when removing the tracing.

• Filing is faster . . . and safer, too . . . with HAMILTON - CALUMET Shallow Drawer Files. They are equipped with a patented *Tracing Lifter*. It makes the bottom sheet in the drawer as easy to file as the top sheet. And it eliminates crumpling, tearing, and creasing. Send in the coupon for full information.

HAMILTON MFG. CO.
Two Rivers, Wisc.

HAMILTON
Drafting Room FURNITURE

HAMILTON MANUFACTURING CO., Two Rivers, Wis.
Dept. MD-12-38.

Send me the complete Hamilton Manual of Drafting Equipment with full information about Calumet Files.

Signed.....

Firm.....

Address.....

City & State.....

Making Full Use of Controls

(*Concluded from Page* 38)

give an automatic reversing spindle, this being tied in with the reversing of the table. In the plain cylindrical grinder we have nine rolling members, seven motors and two generators. A motor mounted on the wheel slide drives the grinding wheel. Coolant pump and lubricating pump are motor driven. Power for the rapid wheelslide movement is furnished by a motor mounted on the quick return case.

In using a motor, a designer should consider building it into his design. By doing so he can improve the appearance of his machine and obtain less broken contours. The motor can be better protected and the bearings can be lubricated automatically as part of the driving mechanism. The motor rotor can be mounted on one of the machine shafts and an efficient drive can be obtained in which belts and couplings may be eliminated. Since the machine acts as an excellent sink for heat, it is also true that a built-in motor will run at lower temperatures under a given load or can run at higher loads without exceeding a safe temperature. It is possible to plan to build the controls and pushbutton station in the machine at convenient points.

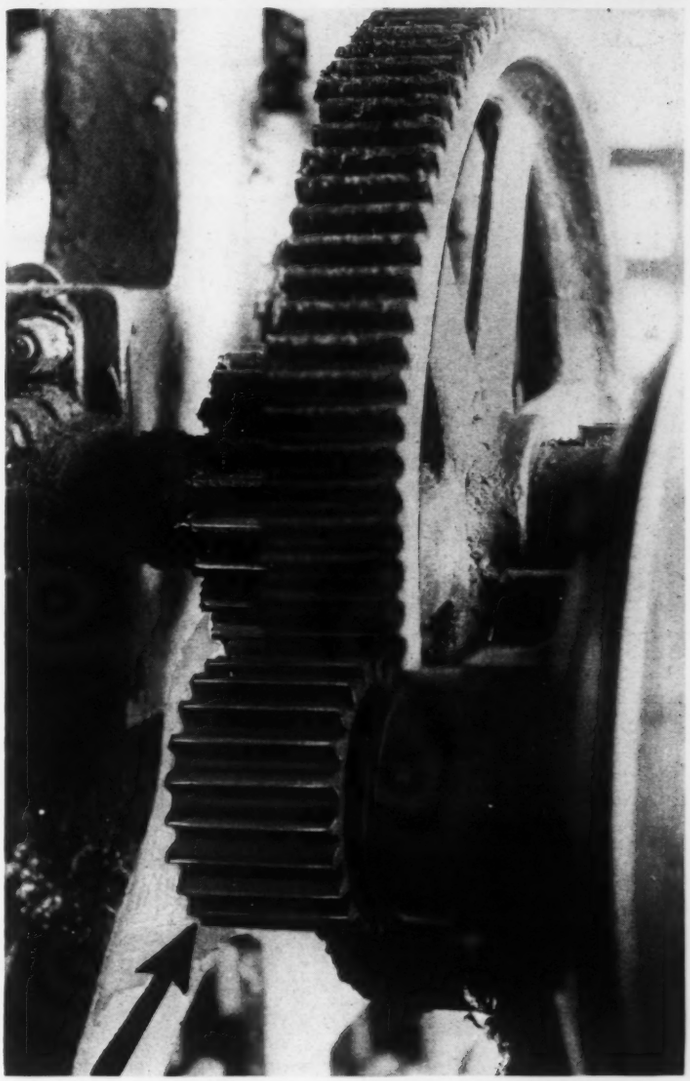
We have given the matter of wiring much study, in order to be able to wire the machine at any stage of erecting. This result is accomplished by the use of prepared harnesses and cast ducts in the machine.

Viscosity Switch Finds Many Uses

In reversing and "plugging to rest," which are possible functions of a motor, we have found a viscosity switch most helpful. At first we had difficulty in finding a viscosity switch small enough or capable of operating at a speed fast enough for use. So a switch was developed which could be applied on the end of a motor shaft running at 3600 revolutions per minute. It is used as a directional switch and is also employed to open the motor circuit when plugging has brought the motor to rest. This directional switch keeps certain circuits open and others closed when the motor is running.

Some of the fundamental advantages which are stimulating the use of electric motors and controls will be readily apparent. These design developments have been rapid during the last five years, but the pace should be quickened in the future. Manufacturers of electrical equipment are cooperating with machinery builders and are working to improve their devices and to adapt them better to machines. Already control designs have changed from large bulky units mounted on the walls of the room to the small compact devices which can be mounted in the machine and operated almost continuously. With the help of the electrical manufacturers, the progress already made can be extended and accelerated.

GOOD SERVICE *under* TOUGH CONDITIONS



Formica makes good where many materials fall down because it is not only durable and shock absorbing, but it is very inert chemically and stands fumes and chemicals that would destroy many gears . . . In tough applications Formica has a good record. It is used as original equipment on many machines where it is important to restrict noise, and it reduces the noise production of many machines already in use when installed by maintenance men . . . Any of the gear cutters named can give prompt service on one or many gears.

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Chicago Rawhide Mfg. Co., Chicago, Ill.
Perfection Gear Company, Chicago, Ill.
Gear Specialties, Inc., Chicago, Ill.
Merkle-Korff Gear Co., Chicago, Ill.

Chicago Gear Works, Chicago, Ill.
Foote Gear Works, Cicero, Ill.
The Cincinnati Gear Co., Cincinnati, O.
Clarksville Foundry & Machine Co., Clarksville, Tenn.
The Horsburgh & Scott Co., Cleveland, O.
The Stahl Gear & Machine Co., Cleveland, O.
The Master Electric Co., Dayton, O.
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Hoell Machine Co., Green Bay, Wis.
Hartford Special Mchny. Co., Hartford, Conn.
Beaty Machine Works, Keokuk, Ia.
The Generating Gear Co., Milwaukee, Wis.
Badger State Gear Co., Milwaukee, Wis.
Precision Machine Co., Milwaukee, Wis.

E. A. Pynch Co., Minneapolis, Minn.
Joaquin Alemany Lopez, Havana, Cuba
The S & S Machine Works, Kansas City, Mo.
Kennedy & Bowder, Nashville, Tenn.
Natisch Gear Works, Brooklyn, N. Y.
New Jersey Gear & Mfg. Co., Newark, N. J.
Prager, Inc., New Orleans, La.
J. Morrison Gilmour, New York City

Sier-Bath, Inc., New York City, N. Y.
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Puritan Machine Co., Omaha, Neb.
E. M. Smith Machine Co., Peoria, Ill.
The Eagle Gear & Machine Co., Philadelphia, Pa.
The Pittsburgh Machine & Supply Co., Pittsburgh, Pa.
Perkins Machine & Gear Co., Springfield, Mass.
Winfield H. Smith, Inc., Springville, N. Y.

Alling Lander Company, Sodus, N. Y.
Charles E. Crofoot Gear Corp'n, South Easton, Mass.
Arlington Machine Co., St. Paul, Minn.
Farwell Mfg. Co., Toledo, Ohio
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ENGINEER'S

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44 Page Data Book

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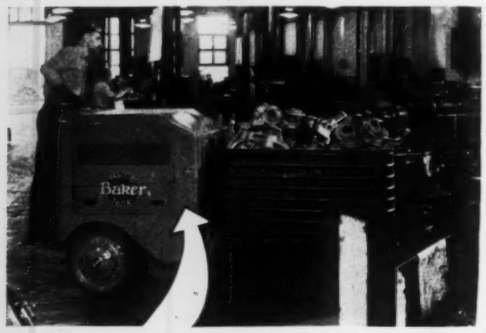

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Baker Gasoline-Powered Elevating Trucks, one of which is shown above, must carry full loads up steep and varying inclines, make long hauls fast, maneuver in narrow aisles, work long hours. This severe service demands a driving clutch that is powerful, compact, reliable, durable, and economical. To meet such requirements perfectly, these Baker Trucks have a Rockford Spring-Loaded Clutch for controlling the main drive, and a Rockford Pullmore Clutch for driving their elevating system.

Rockford Clutches are made in Spring-Loaded and Over-Center Types which may be interchanged. The Spring-Loaded Clutches operate like automobile clutches. The Over-Center Clutches remain positively engaged or disengaged until the position of the operating lever or pedal is changed. Both types are made with single or double drive plates, for operation in oil or dry, in capacities ranging from 2 h.p. to 80 h.p. at 100 r.p.m. Write, today, for complete information.

ROCKFORD DRILLING MACHINE DIVISION

Borg-Warner Corporation, 304 Catherine Street, Rockford, Illinois

Toy Design No Child's Play

(*Concluded from Page* 45)

rangement which is released when the handle is lifted. Springs on the ends of these rods take up the variation in the thickness of the different molds. The operation of the machine is as follows: To pour, the control lever is released from the notch on the right and raised, thus opening the valve and allowing the molten metal to flow. When the mold is filled, the lever is freed and it is immediately drawn back into its slot by a coiled spring. The handle is given a twist to the left, the mold is inverted and, the excess metal is slushed out into a pan positioned to receive it. By releasing the handle the mold is returned to an upright position by means of a spiral spring. The mold is opened by raising the handle.

An almost unlimited assortment of gear trains suitable for driving any model toy is offered by the ingeniously arranged gearbox of an electric engine. It consists of a pair of shafts having worm wheels which engage the worm on the motor shaft and are turned in opposite directions. On each of these shafts are two pinions located so that an idler gear, in moving from one to the next, turns forward, backwards, stands in a neutral position, and then forward and backward again. This idler is shifted laterally by a notched lever which holds it in any of the five positions. The three sets of bearings at the end of the gear box are arranged so that a countershaft in any one of them may be driven from either of the idler gears if the proper secondary gears are used. Also a shaft in the upper set of holes may drive another shaft in the lower holes or vice versa.

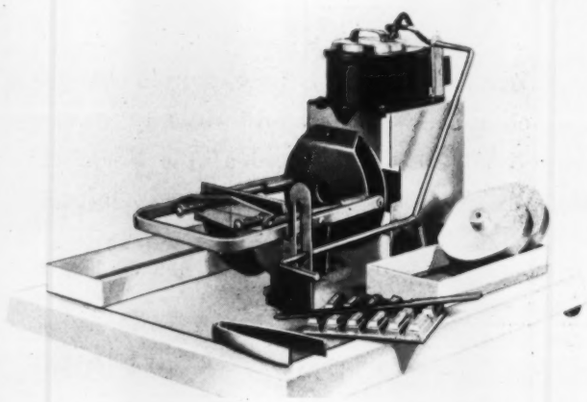
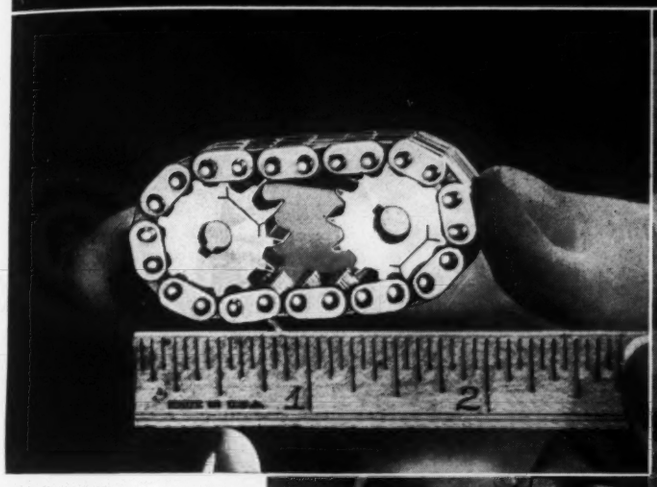


Fig. 3—Slush casting outfit, safe and easy for boy to handle, presents number of mechanical aspects

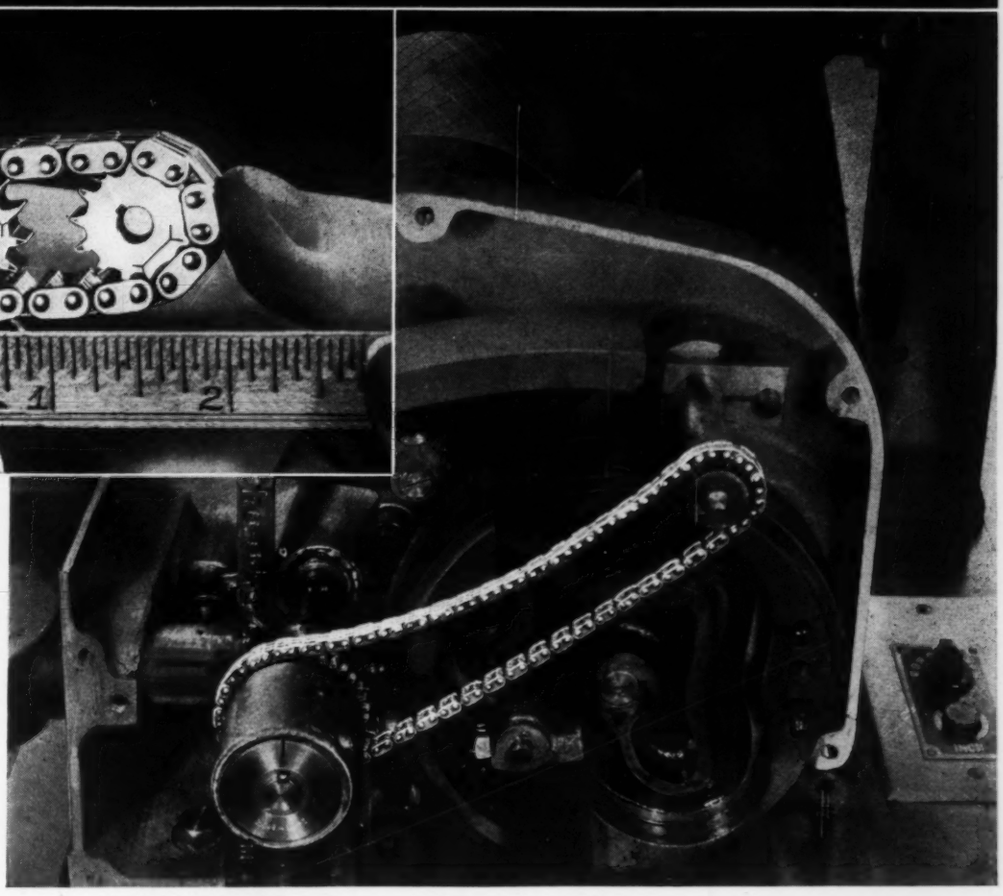
These are only a few of the features of mechanical ingenuity which are appearing on toy counters this year. If an epigram may be pardoned the design of playthings is certainly no child's play!

The following companies were kind enough to cooperate with the editors in the preparation and illustration of this article: The A. C. Gilbert Co. and The Waterbury Button Co.

YOU CAN AVOID SLIP ON SMALL DRIVES, TOO!



This chain is made in three types—middle guide, side flanged, and duplex. The middle guide and side flanged chains are employed where all shafts are driven in one direction, and the duplex where reverse direction is desired on some shaft or shafts, or where adjustment features are required.



Link-Belt 3/16" Silverstreak Silent Chain Drive used on Flag Cutter of cigar making machine, known as the Knurler Drive. Manufactured by American Machine & Foundry Co., for their subsidiary International Cigar Machinery Co., New York City.

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Pat'd and Pat's. Pending Fig. 1510

Cutout section showing Locking Ring in place.

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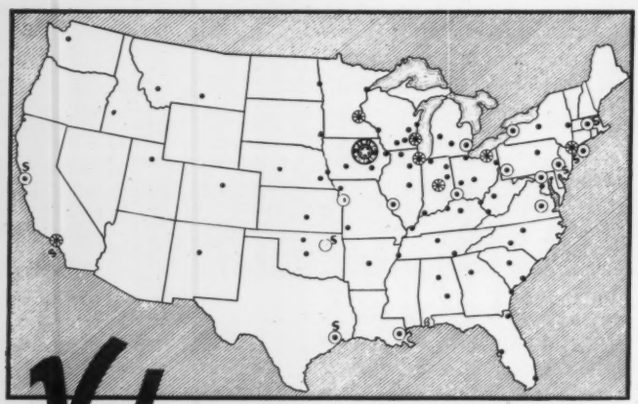

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- Major Distributors
- Major Jobbing Representatives

VIKING PUMP COMPANY
CEDAR FALLS, IOWA

Automatic Typewriting

(*Concluded from Page* 39)

lengthened en route when transmitted over long lines. To enable the receiving distributors to interpret these distorted signals without error they are arranged to receive the selecting impulses only for an extremely short time at the middle of each impulse. This is taken care of in the construction of the distributors. Teletypewriters normally operate at a speed of 368 machine operations per minute.

Messages are recorded in a number of ways. A common method is on a ⅜-inch strip of tape, wide enough for one continuous line of characters. Other machines record on regular page size sheets. Some record on a continuous roll of sheet. Numerous stock market tickers record on a transparent plastic tape in a machine which projects the message on a screen.

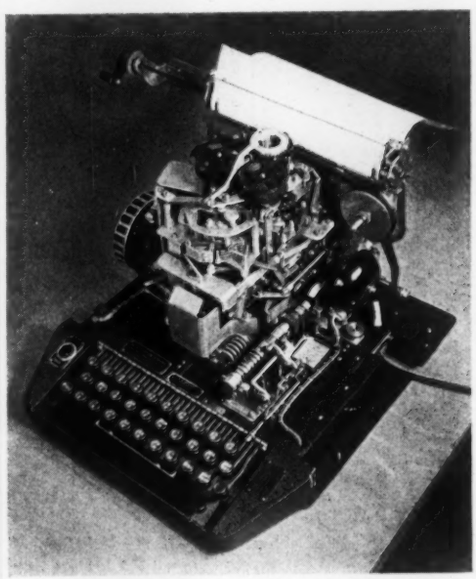
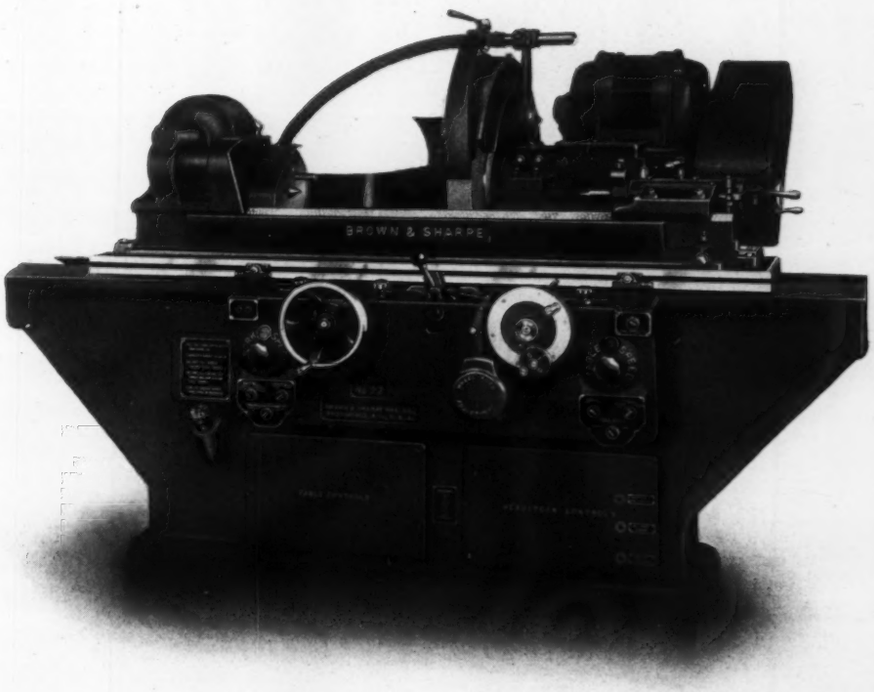


Fig. 3—No. 26 teletypewriter has a movable carriage and type characters are mounted on a wheel

Where a heavy volume of traffic is transmitted, code signals are first punched into tape by a machine known as a perforator. This may be done at any speed within the capabilities of the operator. Tape then is fed through a transmitter and automatically sent.

Modern machines differ somewhat from the fundamental system described in that brush and segment distributors are replaced by a mechanical device with sending contacts and single receiving magnet.

Another feature incorporated in all modern machines is the "overlap" which provides for typing one character while the selecting impulse for the next character is being received. This is done by storing the impulses temporarily in spring-controlled members which are released to control typing when the previous signal has been recorded.



INGENUITY IS DISPLAYED IN APPLYING ELECTRIC CONTROLS

By A. L. Krause
Brown & Sharpe Mfg. Co.

COMPLETE co-ordination and simplification of machine functions can be provided by individual motor drives and electrical interlocking controls. As a pertinent example, attention is drawn to the new Brown & Sharpe electric plain grinding machines, one of the larger types of which is depicted in the heading of this article.

These machines are compact production units having a full range of headstock speeds, table movements and cross feeds and are designed for both traverse grinding and plunge cut grinding. Individual motor drives are provided for wheel spindle, headstock, table, coolant pump and oil pump. The motors are controlled from built-in magnetic switches and relays, responsive in action to simply operated controls grouped on the front of the machine within easy reach of the operator.

The usual group of pushbuttons has been replaced by individual knobs as shown in *Figs.* 1 and 2. The headstock and table knobs each perform the function of a three-unit pushbutton station while the "grind-true" knob operates a selector switch. These selector switches, which can be seen below the table and headstock rheostats in the lower view in *Fig.*

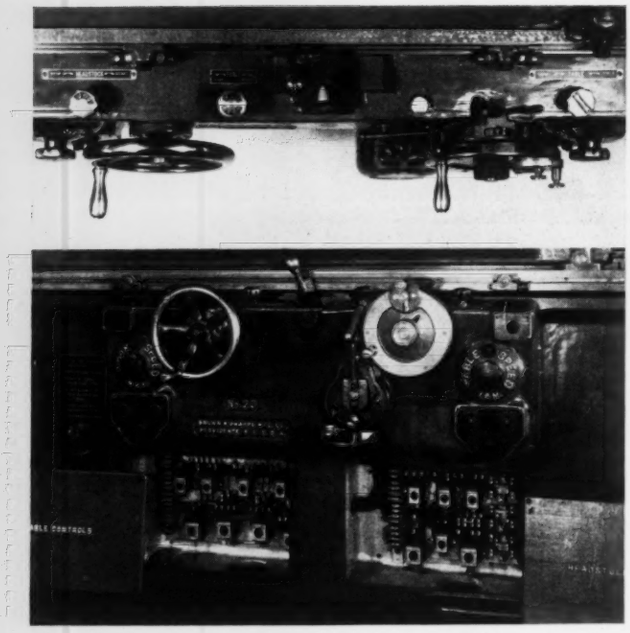


Fig. 1—Headstock, table and "grind-true" control knobs as seen by operator; together with front view of bed, with table and headstock control panels uncovered

1, are used during set-up to give the proper interconnection of control circuits to allow that type of operation which will insure maximum efficiency.

Some of the operating functions made available simply by turning one or more of these selector switches are as follows:

(a) Selection of a semiautomatic cycle wherein slight rotation of cross feed handwheel advances grinding wheel to the work and simultaneously starts headstock, table and coolant pump when setting is for traverse grinding; or headstock, cross feed, and coolant pump when setting is for plunge cut grinding. After grinding operation is completed, rotation of handwheel back to starting position withdraws wheel and simultaneously stops headstock table and coolant pump. If machine is equipped with a wheel slide rapid travel arrangement, wheel can be advanced and withdrawn a constant distance of 2 inches in addition to movement given by handwheel rotation.

(b) Selection of separate or joint starting and stopping of headstock and table by control knob or by handwheel when traverse grinding, and similar selection of separate or joint control of starting and stopping of the headstock and cross feed during plunge cuts.

(c) Selection of high or low speed gearing to table handwheel.

(d) Selection of high or low speed gearing to power table feed (independent of handwheel gearing).

(e) Provision of safety stop for table for use during plunge cuts, thus preventing accidental starting of table.

(f) Selection of length of dwell desired during traverse grinding.

(g) A separately mounted selector switch determines the truing speed, as well as permitting the use of extra slow speeds for grinding.

Versatility and the labor-saving possibilities of electrically controlled functions are well demonstrated by the effects attained through operation of the "grind-true" selector switch which is controlled from knob on extreme right, *Fig.* 1. By turning this single knob the operator can:—

(a) Select extra slow rate of truing speed regardless of setting of the table rheostat and of the position of the selector switch governing high and low speed table gearing.

(b) Eliminate semiautomatic control if it is being used, so that handwheel may safely be turned to bring wheel up to diamond without putting other functions into action.

(c) Eliminate dwell at end of table stroke, thus avoiding loss of time.

(d) Connect the coolant pump so that it will start when table starts. (Normally, coolant pump starts with the headstock, thus saving an extra movement.)

(e) In cases where wheel slide rapid travel motor is provided, render this drive inoperative to prevent possible movement of wheel into diamond through accidental operation of controlling means.

(f) Eliminate table safety stop used during plunge cutting to prevent accidental power movement of table.

Coolant Stops to Allow Work Observation

Other desirable features are also readily obtained by use of individual motor drives and electrically interlocked functions. For instance, while work is being ground, depressing the headstock control knob (which normally would operate the headstock jog to give a slight rotation of the headstock) will act to stop flow of coolant without affecting headstock rotation. This is done so that work conditions can be observed.

The main spindle driving motor for this grinder

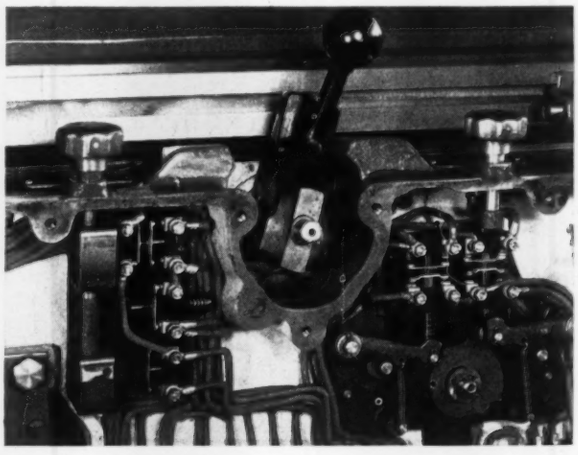


Fig. 2—Details of built-in, knob-operated switch system. Compare with experimental setup, Fig. 3

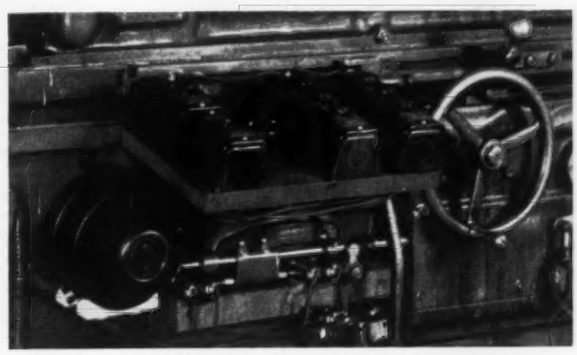


Fig. 3—Array of pushbuttons used on experimental machine to do what one lever in Fig. 2 now does

is rated at 10 horsepower on direct current, or 15 horsepower on alternating current. Selection of the type of motor is of course dependent upon the user's power supply. Even though adjustable speed characteristics available in the direct current motor might be useful to give changes in speed to compensate for wheel wear, the cost and large size of the motor-generator set necessary to operate a direct current spindle drive motor off an alternating current circuit would be prohibitive.

The adjustable speed characteristics required, together with the fact that quick stopping is essential, makes a direct current motor necessary for the headstock drive. This motor has been incorporated as part of the mechanical unit, its driving end shield forming the gear housing for the worm and wheel drive to the headstock. This results in a compact, quiet headstock. A totally enclosed motor is used to eliminate commutator difficulties which might be experienced on applications of this type if means were not provided to exclude the spray from the grinding compound. Direct current is supplied to this headstock motor by a motor-generator set housed in the machine base.

Table Drive Presented Problems

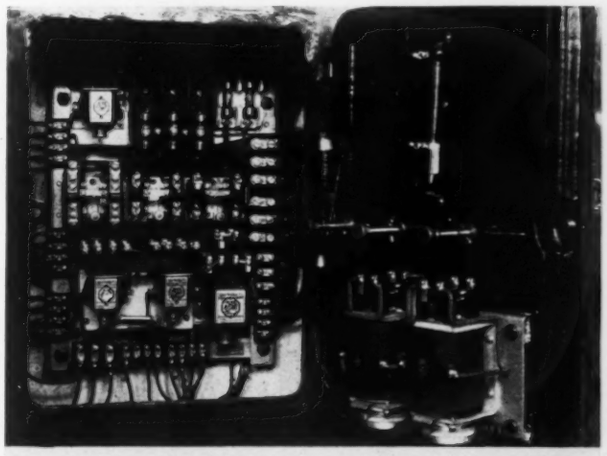
It was only after considerable investigation that the particular type of table motor drive used on this machine, was selected. This drive employs what normally would be a constant-speed direct current motor and supplies its armature with variable voltage from a separate generator. Field circuits of both generator and motor are supplied from the headstock generator. This type of drive was made necessary by the somewhat rigid requirements, which included table speed in either direction varying from 7 to 300 inches per minute, which is a ratio of over 40 to 1. The motor must be capable of reversing frequently because at times operation is at a high speed on very short stroke. Similarly, great accuracy of length of stroke is necessary, the table must stop and dwell when required at either end of the stroke, and the amount of this dwell must be adjustable.

Naturally, an alternating current motor would be desirable because of the simplicity and economy of such a standard motor. In this instance however, the multiplicity of speeds required would make it essential that a considerable number of mechanical changes be available in addition to the speed changes which might be secured from a four-speed motor. Furthermore the size of the four-speed motor would be such that it would be extremely limited in its ability to reverse frequently at its high speed. While it is easy to reverse such a motor rapidly and accurately, it is difficult to stop it with the necessary degree of accuracy without mechanical braking, and the life of such braking unit would be limited.

Pros and Cons of Motor Selection

A direct current adjustable speed motor could advantageously use the same constant-potential generator that is supplied for the headstock motor. In this application, a certain portion of the speed range could be accomplished mechanically, while another portion could be accomplished through the use of armature control of the motor. Thus a 4 to 1 adjustable speed motor would be satisfactory, using a 5 to 1 mechanical ratio to change the speed, giving speeds of 15 to 60 inches per minute, and 75 to 300,

(*Continued on Page* 82)



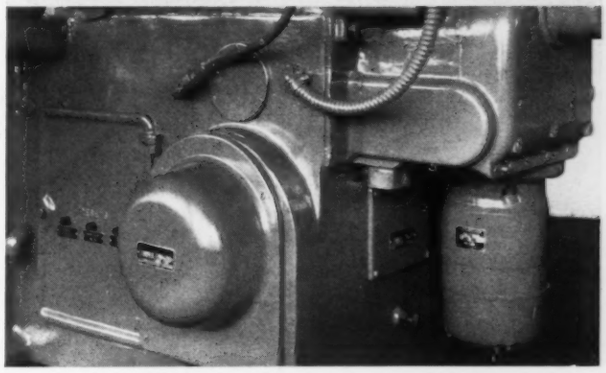


Fig. 4—Top—Door opened to reveal auxiliary control, and also showing dwell relays on inside of door

Fig. 5—Motor-generator is behind domed cover. Vertical motor drives wheel slide rapid travel unit

Fractional Horsep
and Their A

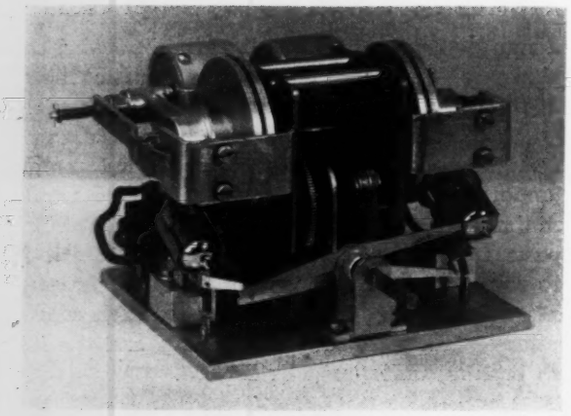


Fig. 1—Timing device employs small synchronous motor, geared down to turn mechanism slowly

RECENT developments and improvements in fractional horsepower motors have encouraged machine designers to utilize them more extensively, not only in laboratory, home and industrial applications requiring less than one horsepower but also in specialized installations where unusual performance is required. Numerous types of small motors include those with design features obtainable in large models, as well as operating characteristics impractical for larger types. The distinctive characteristics of the less conventional fractional horsepower motors in which designers have recently been displaying a great deal of interest include the following:

I. High-Speed Operation
- (a) Series wound, universal motors
- (b) High-cycle motors
- (c) Repulsion-induction types, with different pulley sizes

II. Low-Power Types
- (a) Shaded-pole induction motors, including reversible shaded-pole types and synchronous shaded-pole types
- (b) Impulse, universal motors

III. High Torque at Low Speeds, Including Stall
- (a) Torque motors
- (b) Shaded-pole motors with large gear reduction

IV. Multispeed Control
- (a) High-cycle motors, with frequency control
- (b) Governor-controlled universal motors

V. High Starting Torque, Constant Load Conditions
- (a) Split-phase types—capacitor, reactor, and resistor starting types
- (b) Repulsion-induction motors

HIGH SPEED OPERATION—Demand for high-speed electric motors is on the upswing. Fractional horsepower universal motors and high-cycle motors are being used most widely in this connection. Series-wound, universal motors will operate satisfactorily on alternating or direct-current with a no-load speed as high as 15,000 to 20,000 revolutions per minute. Windage, bearing friction, or a cooling fan load will limit the maximum speed. The majority of universal motors will operate most efficiently at same speed

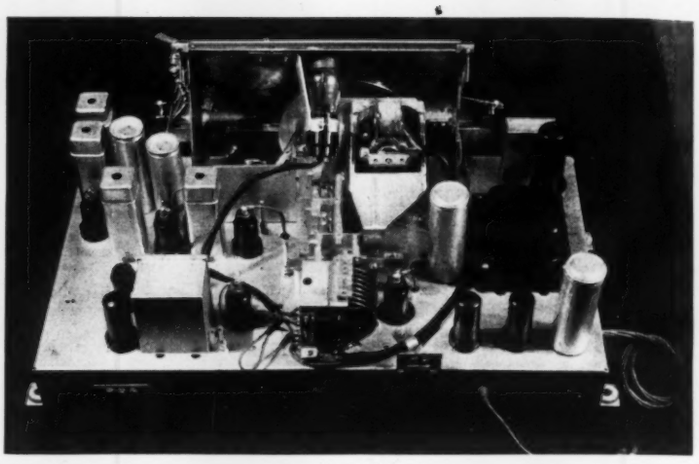


Fig. 2—Reversible, shaded-pole motors, available for different voltages, are used in remote tuning of radio control mechanisms

between 4000 and 8000 revolutions per minute, depending upon the performance characteristics of the motor. Unless governor controlled, they have one serious drawback—they lose speed rapidly on applying load. However, the loads required by grinding machines, boring machines, buffing machines, drills, vacuum cleaners, etc., are not usually severe enough to reduce the motor speed below its efficient operating range. For portable grinding tools and lathe-mounted grinding tools universal motors are highly effective. By gearing down the motor shaft, considerably more power may be obtained at lower speeds.

Small high-cycle motors have been developed to operate on 3-phase, 120-cycle and 180-cycle alternating current. As the speed of an induction type of motor is a function of the frequency, a high-cycle motor will operate two or three times as fast as one operating on 60 cycles, and if geared down in speed the power output will be correspondingly greater. Compared with universal motors there is one feature that is very much in their favor—the speed-load curve is comparatively flat; in other words, the loss of speed with increasing load is not as serious as with the universal motor. High speed routers operating as high as 21,600 revolutions per minute are driven by high-cycle motors. Portable electric hand tools, such as sanders, grinders, buffers, and hand saws, have been the largest consumers of high-cycle motors. These motors, operating on reduced speeds with greater

rsepower Motors
ir Application

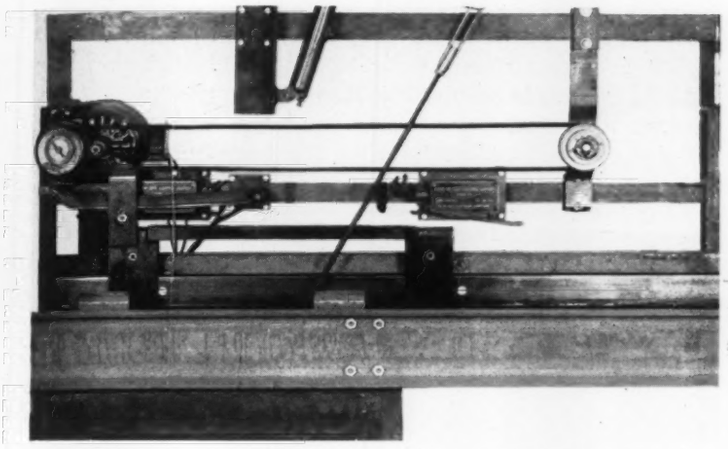


Fig. 3—Gate-opening device is operated by torque motor where stalling characteristic is advantageous

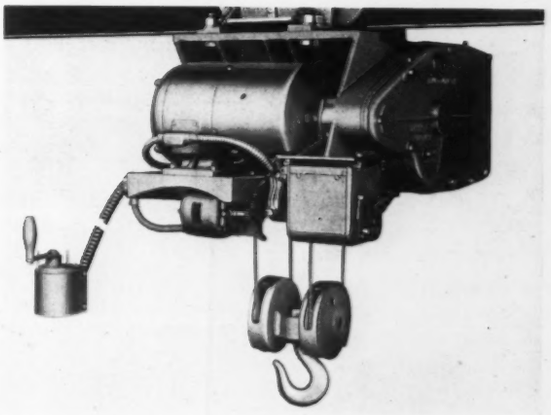


Fig. 4—Control of electric hoist is facilitated by torque motor, used in addition to hoisting motor

torque, have also been used on nut runners, drills, screw-drivers and stud-setters. For high-cycle operation a motor-generator set or frequency changer is necessary to provide the proper electrical energy. Some frequency changers are made variable in order to control motor speeds by raising the frequency to as high as 360 cycles.

There are machines that employ the more conventional alternating current repulsion-induction motor for high speeds and good starting torque by using belt drives and pulleys to step up the speed of operation. Fractional horsepower motors driving drilling and tapping machines are typical examples. Compared with the inherent high-speed, universal and high-cycle motors, more handling is required in the repulsion-induction types, as changing of pulleys may often be necessary to arrive at different speeds.

Low-Power Motors—A large number of applications to instruments, automatic and timing controls (see *Fig.* 1) are employing very small motors with an average input of 2 to 15 watts. The greater proportion of these are shaded-pole motor types. Starting torques, though adequate for the purposes intended, are inherently smaller than wound rotor motors of the same rating. Where the motor has been made synchronous the starting torque is zero, unless special conductors are placed on the rotor periphery to provide a small starting torque. Small synchronous motors have been used extensively in electric clocks and other timing mechanisms.

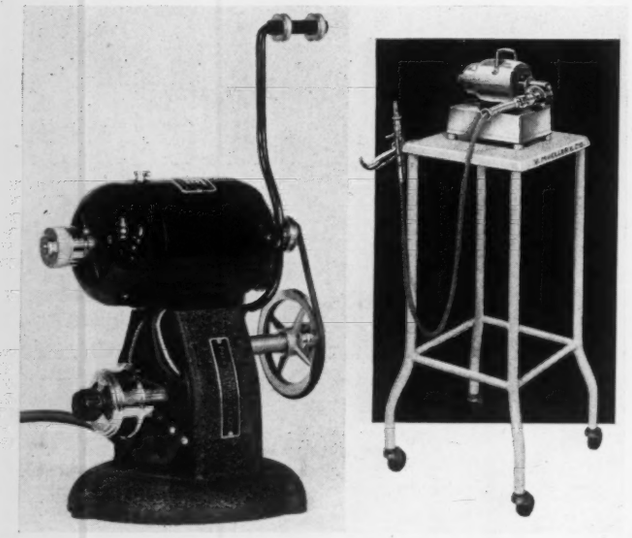
For reversible shaded-pole alternating current motors it is common practice to use two field windings wound in opposite directions, though connected together and brought out in a common center top, and two end leads. Small reversible shaded-pole motors, available for different voltages, are used in remote tuning of radio control mechanisms such as depicted in *Fig.* 2. The motors are rated for short intermittent service and give good torque by means of a large gear reduction. As it is often necessary to permit mechanical hand tuning of the radio, a small clutch mechanism is used to couple the output shaft with the rotor shaft. When the motor is energized the electromagnetic pull on the rotor is used to engage the clutch. Otherwise the output shaft will rotate unimpeded while tuning by hand. Small low-power geared, shaded-pole motors are also used for motor-operated rheostat controls. An adjustable limit switch stop with an auxiliary circuit for an indicating light may accompany this type of unit.

Impulse motors, which are not self starting, fall within the classification of low-power motors. They have been used extensively by electric razor manufacturers. Drawing only 9 watts they will operate on alternating current or direct current. Some mechanical means must be provided for giving the rotor a starting twirl.

Torque Motors—Fractional horsepower torque motors have been finding increasing application during the last two years. Designed to exert strong starting torque on stalled and high inertia loads, their running performance is of secondary importance. As the back electromotive force generated by a rotating armature tends to limit the current flowing to a motor, when the motor stalls, the current input rises accordingly and the average motor under these conditions will burn up. Torque motors are designed to withstand stalled conditions in accordance with

the maximum time they are expected to remain stalled, which may be as high as several hours or a full day. Polyphase, squirrel cage motors with high resistance built into rotor circuit, constitute one group of torque motors.

As for actual applications, torque motors are found in pushing, pulling, and holding devices. On large power machinery they have been applied to operation of power chucks, turning over large commutator arm-



Figs. 5 and 6—At left is a stirring device for laboratory use and at right a motor-driven flexible shaft for surgical instruments, each machine being equipped with variable speed, governor-controlled motors

atures for inspection, and tension controls; also locking devices for gates and elevator doors, and socket wrenches. Among machine tool applications employing torque motors are clamping mechanisms on radial drills, shapers and milling machines. An illustration of a torque motor applied to a door or gate opening device is shown in *Fig.* 3. The use of torque motors on elevator door mechanisms requires an interlocking of mechanisms with the elevator controls, so that the car cannot be started until the door is locked.

Small shaded-pole motors, geared down to the proper torque, have also been used as torque motors for very small loads. The average shaded-pole motor, provided with sufficient air gap, will withstand stalled rotor conditions indefinitely.

MULTISPEED CONTROL—Medium to high torques over a broad speed range are obtainable only in certain types of motors, without the benefit of belt-changing or gear-shifting devices. High-cycle motors provided with variable frequency changers are one type, and governor-controlled universal motors are the other. Inasmuch as special generators are required, variable speed high-cycle motors usually are limited to plants equipped with a current supply of that type. On the other hand, there has been an extensive use of governor-controlled universal motors. A typical unit, illustrated in *Fig.* 5, depicts a stirring device for calorimeters, tumblers and many other laboratory devices. The governor control knob may be seen at rear of the motor. Motors of this multispeed type are also used in driving flexible shafts for surgical instruments, *Fig.* 6, and in home appliance food mixers.

The governor allows full power to be delivered to the motor at any speed. This permits operation at low speeds without loss of torque. In the governor the line current is delivered through two contact points by means of brushes and governor commutator. One of the contacts is movable, with its movement restricted by the setting of the governor control knob. When a certain speed is exceeded centrifugal force opens the contact points, breaking electric power delivered to motor. This occurs many times in one second and the speed of the motor shaft does not vary. As load is applied the shaft tends to slow down and contact points remain closed, delivering full available power to the motor. The trick of every governor is to control properly the movement of the movable contact point from an outside setting. In the unit illustrated in *Fig.* 5, this is accomplished by shifting a molded plastic knob against a contact spring at the center of rotation. A resistor and condenser are shunted across the contact points to reduce current surges and absorb arc energy. Before the introduction of governors, motor speed control was effected through current limiting rheostats that seriously cut down the power delivered to the motor at low speeds.

Good Starting Torque Often Advantageous

HIGH STARTING TORQUE, CONSTANT LOAD MOTORS—A large number of split-phase, fractional horsepower motors, and repulsion-induction motors, have been adopted as standard by designing engineers. Much has been published on their comparative merits, and rather than repeat old data, recent design trends and applications will be reviewed. Motor manufacturers have been featuring high torque general purpose capacitor motors. Usually, capacitor start is employed to receive the benefit of a high starting torque, though it is not necessarily maintained during running conditions, means usually being provided to cut out the condenser automatically while the rotor is speeding

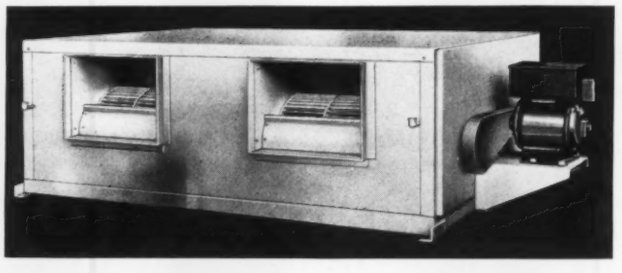


Fig. 7—To receive the benefit of high starting torque, a capacitor start motor is used with air conditioning unit

up. However, some efficient designs use capacitor run as well as capacitor start. The one-half horsepower motor driving the air conditioning unit in *Fig.* 7 is an example.

Some manufacturers have available new thermal overload switches built directly into the motor windings, which open the motor circuit when the windings reach a maximum safe operating temperature. Sometimes they are made sensitive enough to respond rapidly to dangerous currents which might occur due to a locked or stalled rotor. These refinements all tend to improve the general high caliber standards of the motors.

Mechanical Developments Improve Adaptability

Developments in small motors have not been confined to electrical features alone, as there is an increasing tendency among motor manufacturers to incorporate mechanical features to make the motors more easily adaptable to other installations. There is a trend to flange mountings integral with bearing brackets rather than the motor frames. This leads to smaller housings and a unit more easily adapted to machines, particularly where vertical and angular mounting is required. Motor frames have been revamped in some designs in an effort to minimize the transmission of motor vibration to the supporting surface. This has been accomplished by (a) a vibration dampening device integral with method of mounting, attached to motor frame, and (b) a metal ring bonded with rubber on the inside to support the motor frame.

Increasing co-operation between the machine builder and motor manufacturer is evidenced by the development of a line of shell type, shaftless motors, *Fig.* 8. In the design of directly-driven spindles this arrangement is ideal, as space is conserved and power more efficiently applied. It does not suit all operations, however, as lower speeds than the motor is capable of delivering are frequently required. Shaftless motors are available commercially from one-quarter horsepower up. The motor characteristics of these types must be carefully co-ordinated with the requirements of the individual tool.

Another design trend of interest is the built-in gear reduction on small motors. There are so many applications at which the desired operating speed of the device differs appreciably from that speed at which the motor will operate most efficiently that gear reductions are indispensable. When timing devices are to be operated, such as the one depicted in *Fig.* 1, synchronous speed is essential. In the illustrated timing device, a small shaded-pole synchronous motor controls the timing sequence of operations on a milk pasteurizer. The use of mercury switches and the gear train reduction should be noted in particular. Small synchronous geared-head motors have also been developed for recording instruments and other accurate timing devices. Some manufacturers have standardized on 1800 to 1, 900 to 1 and 300 to 1 for their gear reductions.

Higher speeds, often required of medium speed small electric motors, are usually obtained through interchangeable pulleys and a belt drive, with means for taking up the belt tension. A motor of this description, of one-eighth horsepower, with a rated speed of 3450 revolutions per minute, drives a sensitive drilling and tapping machine at speeds up to 9500 revolutions per minute. Though mounted upon the same base as the support for the rotating spindle, the motor may be moved independently to adjust tension upon the belt drive. The belt is entirely housed within the unit, making a neat appearance with its black, crackle finish. Belt drives are also popular on some units for reducing the speed of the motor to that suitable for the specific machine application. An outstanding example of this is the large air-circulating fan installed in the attics of many American homes to make the air more tolerable during hot summer months. A small motor installed with cork cushioning drives a large fan by a short-center, high ratio V-belt, and an efficient air-circulating system is thus established.

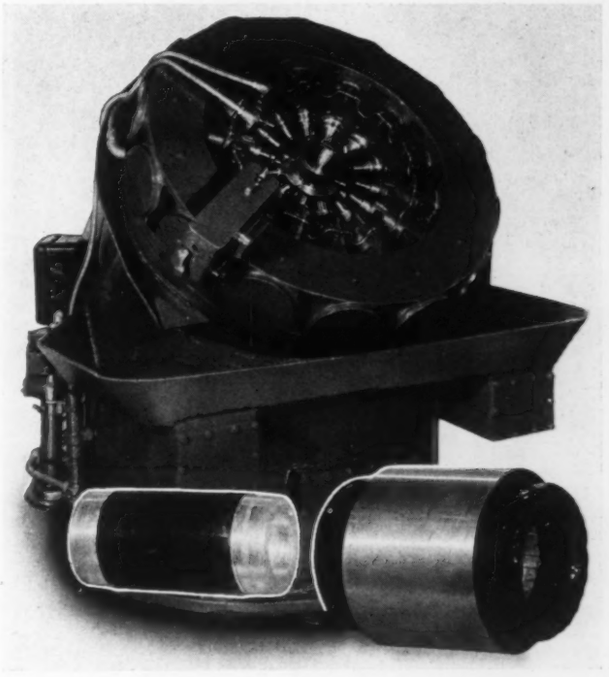


Fig. 8—Inset shows shell-type, shaftless motor for spindle drive, a number of which are built into the piston drilling machine depicted

For their assistance in furnishing illustrations in this article MACHINE DESIGN is indebted to the following companies: The Louis Allis Co., Barber-Colman Co., Bodine Electric Co., Delco Products Division, General Motors Corp., H. R. Krueger & Co., The Ohio Electric Mfg. Co., RCA Manufacturing Co. Inc., Robbins & Myers Inc. and Wagner Electric Corp.

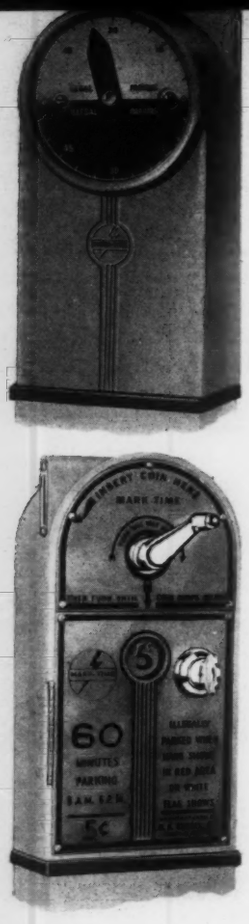


Fig. 1—Parking meters employ clock-like timer to keep check on period parking space is in use

TIME CONTROLS ARE B

CONSTANT demand exists for any mechanism that will lessen operator responsibility and effort. Today we find a great many machines equipped with time controls of various types to reduce or eliminate human supervision in their operation. The layman as well as the designing engineer is acquainted with the growing prevalence of timing devices on domestic appliances. Stoves, washing machines, furnaces, therapeutic lamps, etc., are now equipped with timing instruments of one kind or another that make the machine automatic or nearly so. In industry, timers are found on the simplest motor starter and the most elaborate steel mill or planer controller. There is hardly a large process machine that does not make use of some form of timing device running in cost from a few cents to several hundred dollars.

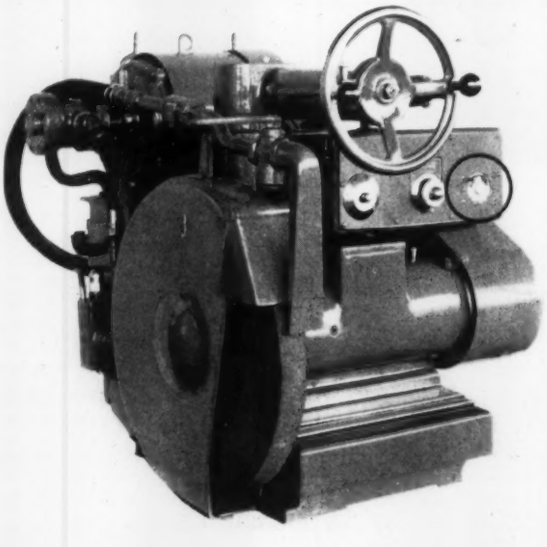
Not only are timers a convenience and labor saver, but without them some machines would be impractical. Parking meters (*Fig.* 1) that keep track of the time a vehicle is parked at the curb depend for their operation on a clock type, spring driven timer. All types of coin operated machines have timers built in that regulate the interval lights will be on or the machine may be manipulated. Among the coin machines there are automatic shoe shining devices, washroom blowers for drying the hands, light meters for public tennis courts and various games of chance. In the beauty parlor field the public antipathy to electric permanent hair waving machines has been overcome by the use of timers and these machines are now about 100 per cent equipped. *Fig.* 4 shows such a machine with dials for the three timing instruments easily visible. The ease of operation and reliability of apparatus in the medical field, photo engraving, printing, and laboratory are due to time-control instruments that are part of the machine.

One field that so far has not adopted timers extensively but in which great possibilities lie is radio. By the application of timers, radios can be automatically turned on for special programs that are broadcast daily and silenced for unwanted offerings.

Perplexing to the designing engineer is the choice of the correct timing instrument for his machine. Many types are on the market and he must have some knowledge of their individual characteristics to be able to select the one most applicable to his needs.

Classification of these devices is somewhat puzzling

Fig. 2—Spark out interval at end of each grinding operation is automatically regulated by time control built into grinder and shown in circle



RE BRAINS" OF MACHINES

as each manufacturer has his own system. Some classify timers according to their mode of operation; others according to their timing function. In fact the division between limit switches that have a short dwell period and time controls that can be regulated and set for predetermined intervals is not well defined. According to the mode of operation time controls might be divided into (1) thermal or heat actuated timers, (2) inertia and dashpot devices, (3) inductive time delay relays, (4) solenoid operated escapement types, (5) motor-driven timers, (6) spring-driven timers, and (7) electronic type time controls.

Classifying by their type of operation, timers are immediate recycling, not immediate recycling and repeating. By immediate recycling is meant a timing device that is ready to start a new cycle as soon as it has completed one when power is removed and again restored. Not immediate recycling is a term that covers those devices in which there must be a short delay before the unit is ready to operate again. A timing device that repeats its cycle over and over when power is applied is a repeating type.

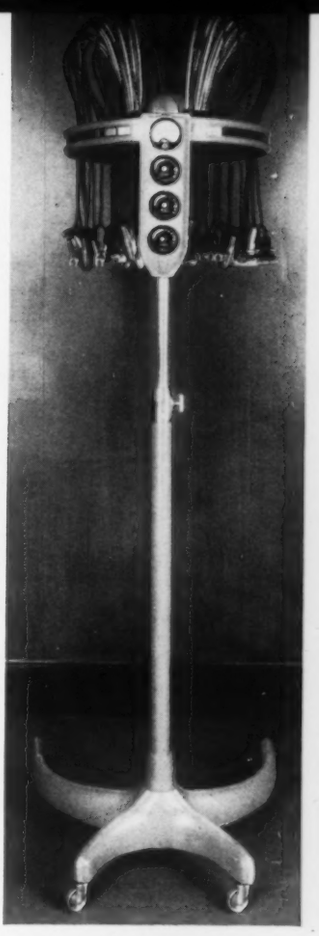
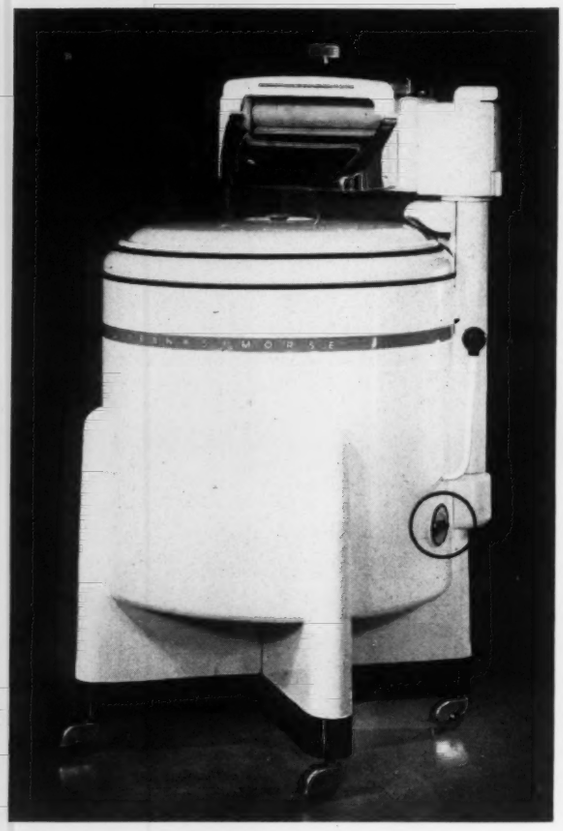


Fig. 4—Three timers are built into the permanent hair waving machine for control of different operations simultaneously

Fig. 3—To prevent patient from receiving overdose of violet light rays, spring timer seen in middle center of machine is provided

Probably the simplest is a thermal timer, a type not immediately recycling, consisting of a bimetallic element relying upon the heating action of the current to deform it and make or break contact. This type of delay relay, as it is often called, is admirably suited for cutting out the capacitor after starting on small capacitor motors or for any short time operation where it is practical to cut the heater element out of the circuit after it has acted and there is sufficient interval for the timer to cool before it operates again. This type of timing device is used for such applications as furnishing adjustable dwell on automatic lathes, control of oil burner ignition and the most common use—to delay the application of plate current to vacuum tubes until the filament is partially heated.

Describing timers in the order in which we have classified them according to mode of operation, we find inertia and air dashpot delay units are popular for certain applications. These devices are particularly valuable where there is an absence of electric current to operate the more common time controls. Air dashpot time delay units also have been used to delay the application of current in spot welding and to



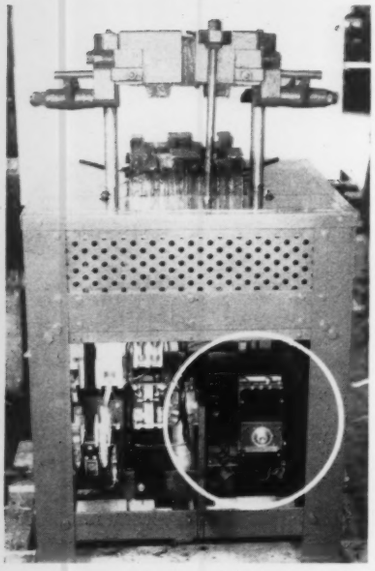


Fig. 5—Selling feature of this new washing machine is easily adjustable time control mechanism

Fig. 6—Entire cycle of operations on this ring gear expanding machine is controlled by synchronous motor - driven timer

Fig. 7—Operation of clothes washer is entirely automatic due to precise control possible with built-in timers

hold contacts closed for an interval when no power is present. Inertia type timers are used to provide brief time delays between two successive operations. Timers of this type are not immediate recycling as a considerable period elapses before they are ready to operate again.

Where simplicity and ruggedness are of prime importance the inductive time delay relay is a logical choice. This relay is generally made up of a heavy magnetic circuit, a magnetizing coil and neutralizing coil. The magnetizing coil is first energized, opening or closing the contacts before the time contactor closes —the line or "initiating" contactor then closes, short-circuiting the relay magnetizing coil. The flux will then decay in the magnetic circuit of the relay coil at a rate dependent on the excitation of the neutralizing coil. This type of relay is not immediate recycling and must be used with direct current, or if applied with alternating current, suitable rectox rectifiers must be provided.

Another popular form of the not immediate recycling timer is the solenoid-operated escapement type which will close one circuit instantaneously and transfer current to another circuit after a time delay. This relay is generally obtainable in various forms providing up to 20 seconds delay.

Motor and Spring Driven Timers

By far the most numerous and widely applied timers are those listed as (5) and (6), motor and spring-driven types which will be considered together. They are available in the three function types and are particularly applicable for recycling and repeating uses. As devices for measuring elapsed periods they control short interval, sequence and cycle operations with precision and reliability. Synchronous motors drive the electric type and where current of controlled frequency is available these units will run indefinitely without attention. Timers which run continuously month in and month out are termed chronological timers and have many applications. Chronological timers control stack draft regulators, school program panel boards, astronomical instruments. etc. If alternating current is not available small direct current motors are used which keep a constant spring tension in a spring-driven timer.

For controlling short intervals of elapsed time we usually find a spring-driven timer built into the machine. Energy is stored in the spring by movement of a crank or lever which starts the machine and after a predetermined period the timer causes the machine to stop. Coin operated amusement devices, toasters, parking meters, etc., are everyday applications. In these devices it usually is not possible to regulate the elapsed time as this is definitely set in the manufacture of the machine.

Motor and spring-driven timers which may be ad-

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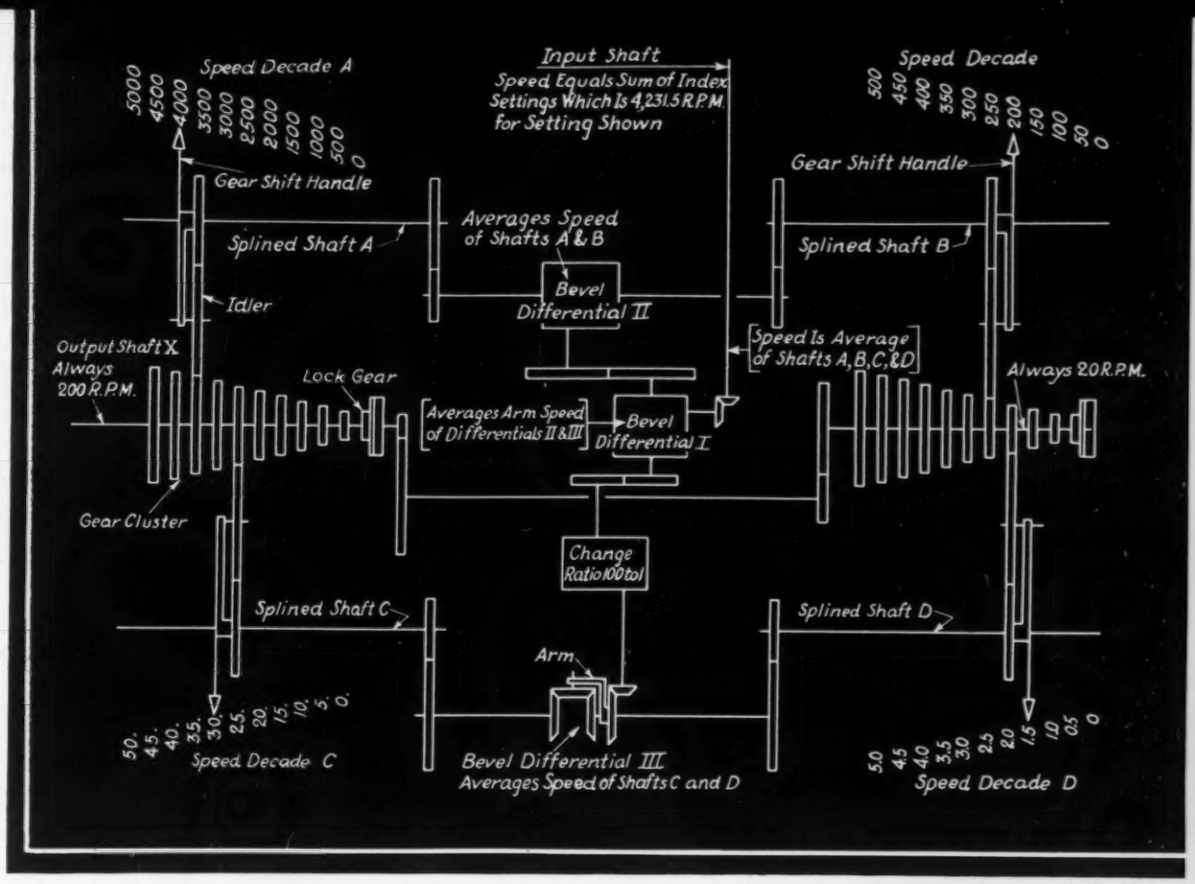

Fig. 1 — Diagrammatic layout shows how a great number of speeds are possible by use of differentials in gear system

Range of Variable Speed Drive Increased with Differentials

By
R. C. Binder

VARIABLE speed drives, as the name implies, permit an almost infinite number of speeds. In certain types, however, particularly where simple gearing is utilized, different speeds and also the range of speed are restricted, the gears being arranged on fixed axes. Designers often have need for variable speed units of this type because the drive is positive and no slipping can occur. To keep the advantage of positive drive and give a greater range and number of speed ratios, differentials may be incorporated in the transmission.

With the four gears shown in *Fig.* 4, to cite a particular instance, there is only one definite speed ratio if the axes are fixed. By employing additional, sliding gears the number of speed ratios can be increased, but the increase is limited and sometimes obtained only with much trouble and expense. A great number and

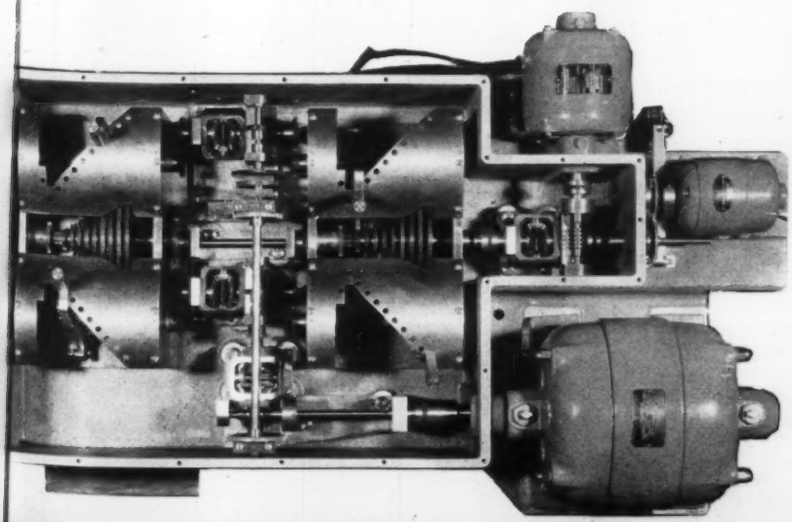

Fig. 2—Variable speed unit was designed to meet special needs in hydraulic laboratory

variety of speed ratios is possible, on the other hand, by arranging one axis (axis *A*, *Fig.* 4) to move on an arm; the result is a spur gear differential or form of cyclic train.

Probably one of the simplest forms of differential is

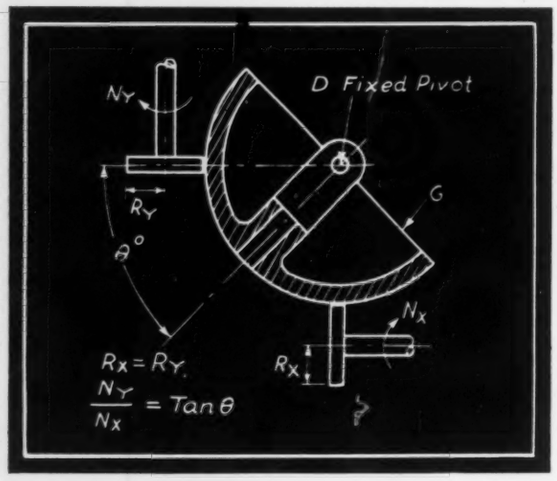

Fig. 3—Rate of speed change in this type of unit becomes greater as rotating axis of hemispherical member approaches one of the shafts

that employing bevel gears, which has familiar use in the rear end of an automobile. Referring to *Fig.* 5, if the speed of one shaft is N_1 revolutions per minute and the speed of the other shaft is N_2 revolutions per minute the RPM of the arm is the algebraic average $N_1 + N_2/2$. "Algebraic" signifies, of course, that the directions of rotation must be considered. If one shaft has the same angular speed as the other, but in the reverse direction, the arm does not rotate. As a numerical example let gear *B* rotate at 180 RPM in one direction arbitrarily called positive, then $N_1 = +180$ RPM. Let gear *C* rotate in the opposite direction at 100 RPM, then $N_2 = -100$ RPM. The algebraic average of the shaft speeds is the speed of the arm $= +180 + (-100)/2 = +40$ RPM, in the direction arbitrarily called positive. This mathematical relation is

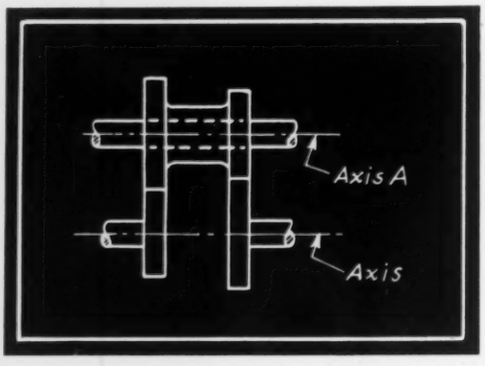

Fig. 4—When the axes are fixed as in this case there is only one definite speed ratio

true regardless of the absolute number of teeth on gears *B* and *C*, the only requirement being that gears *B* and *C* should have the same number of teeth.

As an example of how differentials may give a nice solution the following design problem and procedure is cited. The problem presented was to design a variable speed device which would always give an output shaft speed of 200 RPM for any input shaft speed up to 5555 RPM in steps of 0.5 RPM. This was a kinematic problem in instrument design for the power to be transmitted was only enough to overcome friction. Over 11,000 different speed ratios were finally attained with a relatively small number of gears.

Friction Drives Studied

Speed cones and other friction drives were first studied in an attempt to obtain the great number of speed ratios. Considerations of positive driving and uniform sensitivity, however, led to the final decision to adopt an all-gear drive. For instance, the hemispherical friction drive occasionally used on drill presses does not give a uniform sensitivity. Referring to *Fig.* 3, the hemisphere *G* rotates on an axis which pivots at *D*. As the angle θ is changed the speed ratio

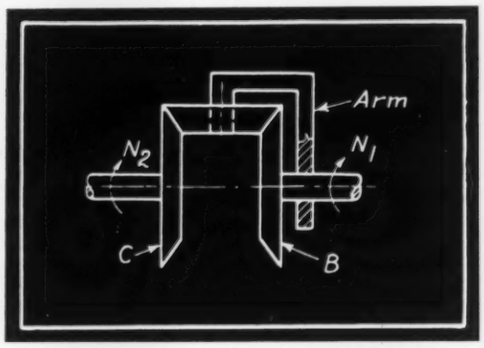

Fig. 5—Common type of speed changing unit is that employed in ordinary automobile differential

is changed, but the speed ratio N_y/N_x varies directly as tangent θ; thus at large values of θ the speed increment is greater for a constant angular change than at the smaller values of θ.

To produce over 11,000 different speed ratios with gears on fixed axes, a cumbersome gear box with a comparatively large number of gears would be required. It was possible to obtain a relatively clean cut design, however, by employing 72 gears, including three bevel gear differentials and only four shift levers. Some of these gears were not necessary from a kinematic point of view, but were used as a convenience in assembly. In each differential only three bevel gears were necessary kinematically, but a fourth was

(*Continued on Page* 94)

"OUR DESIGNERS SPECIFY . . . ."

ONE of the most effective ways to gain some degree of familiarity with a design subject is to sit down with an experienced engineer and have him tell of the problems with which he himself has been faced and how he has dealt with them. In behalf of the readers of MACHINE DESIGN, the editors have—literally as well as figuratively—sat down lately with a number of well-known engineers and designers.

Presented herewith are literal transcriptions of what these men have had to say concerning some of the interesting drive and control problems with which they recently have been confronted; their line of reasoning in dealing with them; and the practical results achieved through the designs which they have developed. While these interviews cover only a few of many aspects of an extraordinarily broad and important subject, they cover them in a manner which will be inspiring to those with problems still to be solved.

". . . . . or variable speed V-belt drive."

L. R. TUFTS, Engineering Department
Dexter Folder Co.

THE usual method of designing a variable speed drive—using gears, step pulleys or electrical control—has been first to determine minimum and maximum speeds required and then to figure the intermediate speeds step by step by geometrical progression, the number of steps being determined by practical considerations or by considerations of economy.

Increased production which usually is demanded from modern machinery has meant a general increase in the maximum speed of the average piece of equipment. At the same time a minimum speed is still required to meet the same low speed conditions as prevailed heretofore. This condition of things has resulted in the majority of cases in bringing about greater steps from speed to speed throughout the range from minimum to maximum.

We find that the general operation of modern equipment is largely at its higher speeds—specifically, that the upper third of its speed range is used the greater part of the time. In this upper third steps from one speed to another usually are so great that oftentimes it is impossible to obtain just the speed desired for most efficient operation.

Because of these excessively long steps from one speed to another in the "upper bracket" of the average present day speed range, as provided by a geometric progression set-up, we are inclined to give favorable consideration to variable speed friction or variable speed V-belt drives.

". . . . . any speed from 600 to 3600 r.p.m."

F. J. KISTNER, Chief Engineer
J. A. Fay & Egan Co.

WE HAVE recently developed a new variable speed wood turning lathe with a single lever control unit built into the headstock for starting, stopping and speed changing. The headstock, which is ball bearing equipped throughout, carries a rigidly mounted fractional horsepower motor, there being adjustable V-sheaves on both motor shaft and the work spindle. Short center drive is effected between motor and spindle by a specially molded, wide, rubberized cord V-belt.

Control is by means of an "in and out" hinged ball handle lever which in its extreme positions operates an electric switch which makes or breaks all phases of the motor circuit. Swiveling of this lever through an arc of 60 degrees expands and contracts the V-sheaves by linkage connections, thus giving an infinite number of speeds from 600 to 3600 revolutions per minute. A spring-loaded friction plate located on the rear of the swivel lever retains the lever in any intermediate position, while a ball—backed by a spring—engages in grooves on the switch-operating shaft to determine the extreme hinged positions of the lever.

A unique feature of this control is that its sheaves must be adjusted for low speed before the motor can

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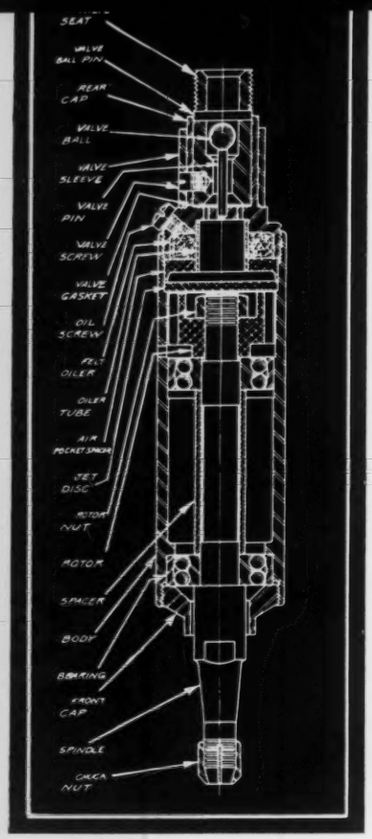


Fig. 1 — Relation of parts is shown in small air - driven grinder. Pneumatic tools of this type reach speeds of 100,000 RPM

Quick Action, Safety Assured by

By John H. Johanson

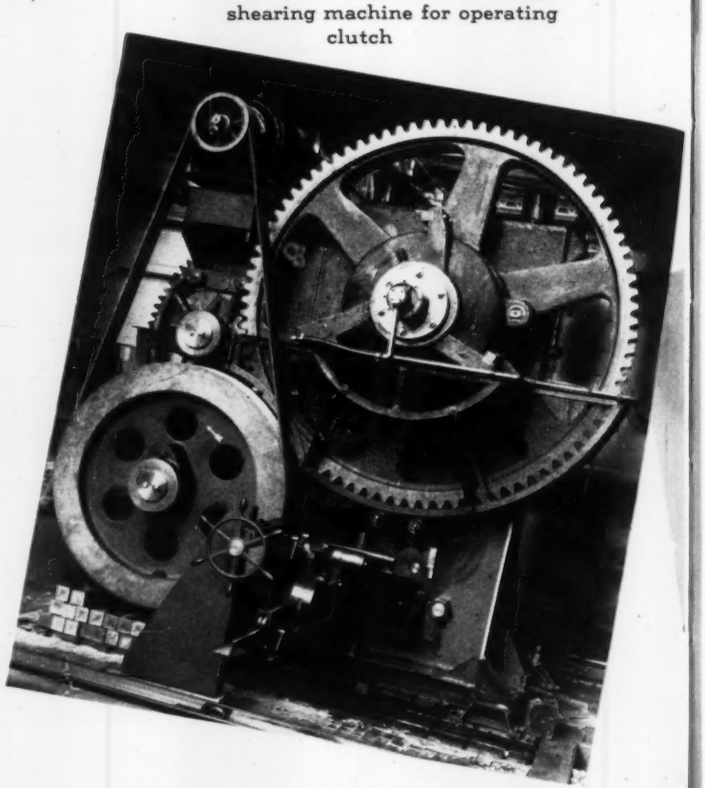
PNEUMATIC drives and controls in recent years have become increasingly popular. Engineers are realizing the versatility of air operated devices and are specifying them to perform a wide variety of functions on new machines. This adaptation of pneumatic equipment is proving highly satisfactory and many operations which in the past were performed manually or only with considerable trouble by other forms of power are now easily accomplished with quick acting, shock absorbing air cylinders.

The application of pneumatic clutches on heavy machinery, for instance, has done much to speed up operation and promote handling ease. In *Fig.* 2 a Buffalo shearing machine is depicted with a pneumatic cylinder built in to operate the clutch. The piston rod is secured to the main shaft and allows the cylinder body to move back and forth to engage the clutch. An air valve, operated by a cam as the shaft revolves to shear the work, opens at the proper time and releases pressure to a pneumatic clamping cylinder which holds the work. Air controls were incorporated in this shearing machine at little increase in cost over the hand operated type.

Many benefits are made possible by the great flexibility and uniform instantaneous action offered through the use of pneumatic drives and controls. One characteristic of pneumatic cylinders is that a long piston movement may be accomplished with great speed and with uniform power at all positions of the length of travel. On the new four-motored army bombing airplanes, pneumatically operated bomb doors are incorporated. It is because these doors must open and close with considerable speed and their movement is great that an air operated system is used.

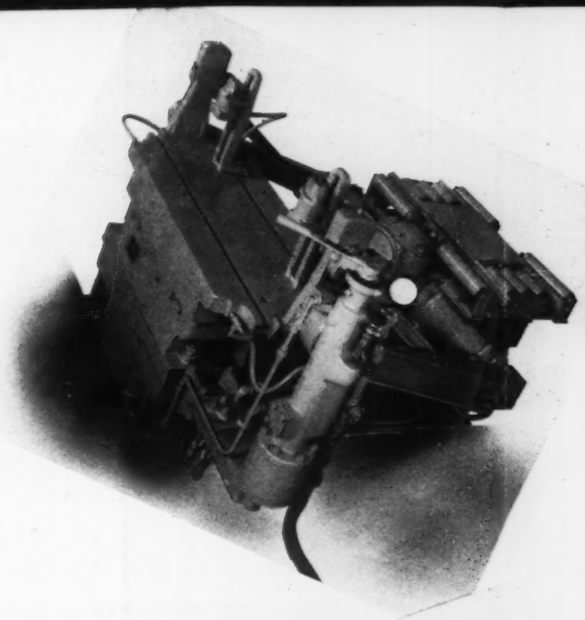
In machine operation one of the principal advantages of air under pressure is convenience, as practically every industrial plant is equipped with apparatus for producing compressed air. Of importance also, in considering the use of pneumatically

Fig. 2—Pneumatic cylinder is built into flywheel hub on large shearing machine for operating clutch



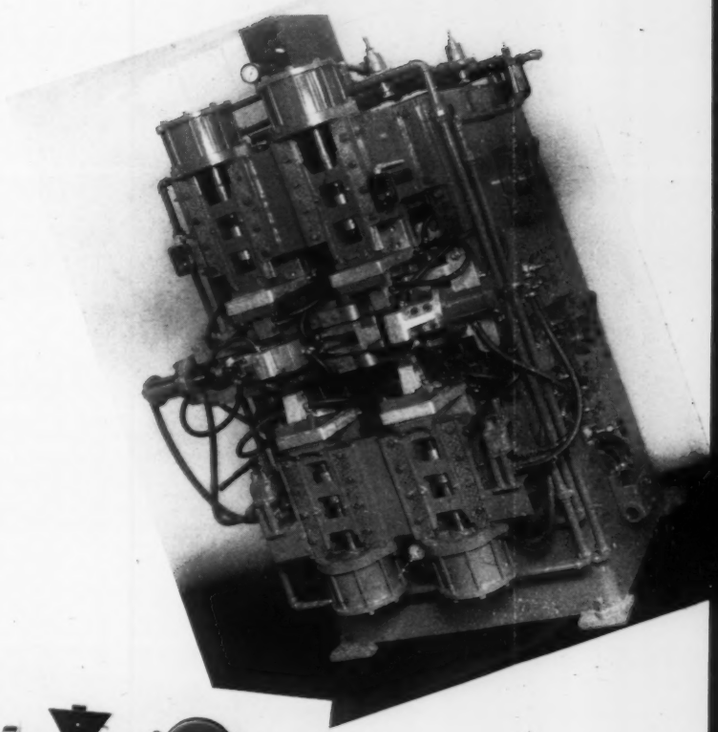
and Effectiveness

Pneumatics



operated devices, is the safety feature of a pneumatic unit. If a mechanism is hindered in its movement the air cylinder will stall, whereas with a positive mechanical drive damage will probably result. The cushioning effect obtained with a pneumatic device is also advantageous—jar and shock which might otherwise be troublesome are readily overcome.

A great number of air operated machines and tools have recently been put on the market with marked success. The slightly higher cost of pneumatic equipment over other types of power drives and controls has hampered progress to some extent. Nevertheless there are innumerable applications where the efficiency, small size and light weight of air equipment have more than compensated for the higher cost. In fact there are actually cases where the results obtained by pneumatic units could not other-



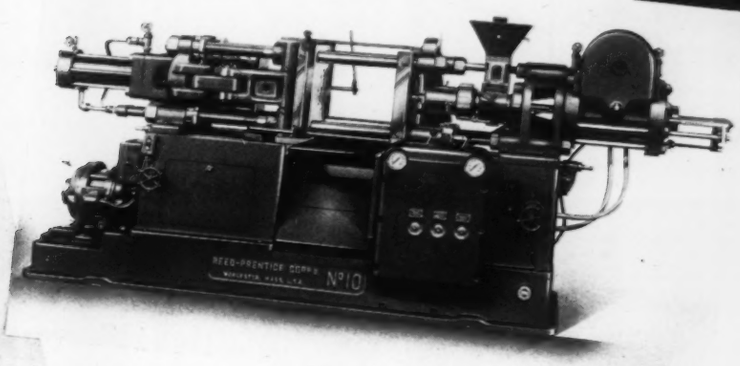


Fig. 3—Foundry molding machine (top of page) has air-operated jarring and clamping mechanisms. Fig. 4 (just above) Two pneumatic cylinders on double acting resistance welder clamp work and other four cylinders force electrodes together

Fig. 5—Dies are quickly moved into place for injection molding by two air cylinders on plastic molding machine.

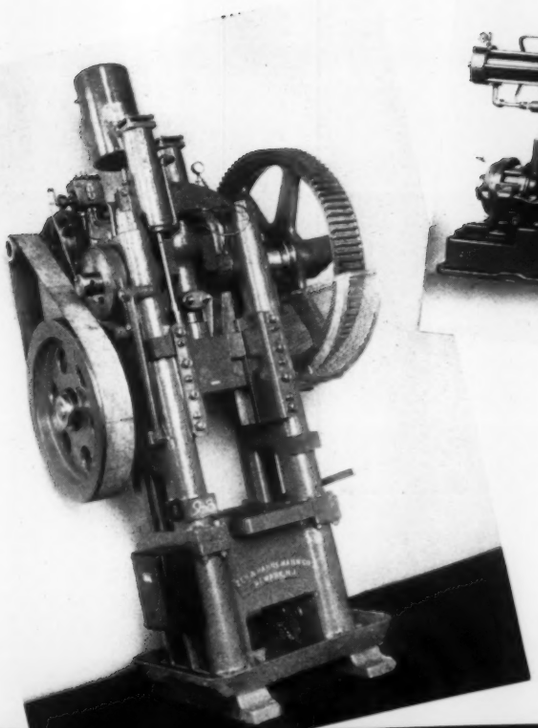
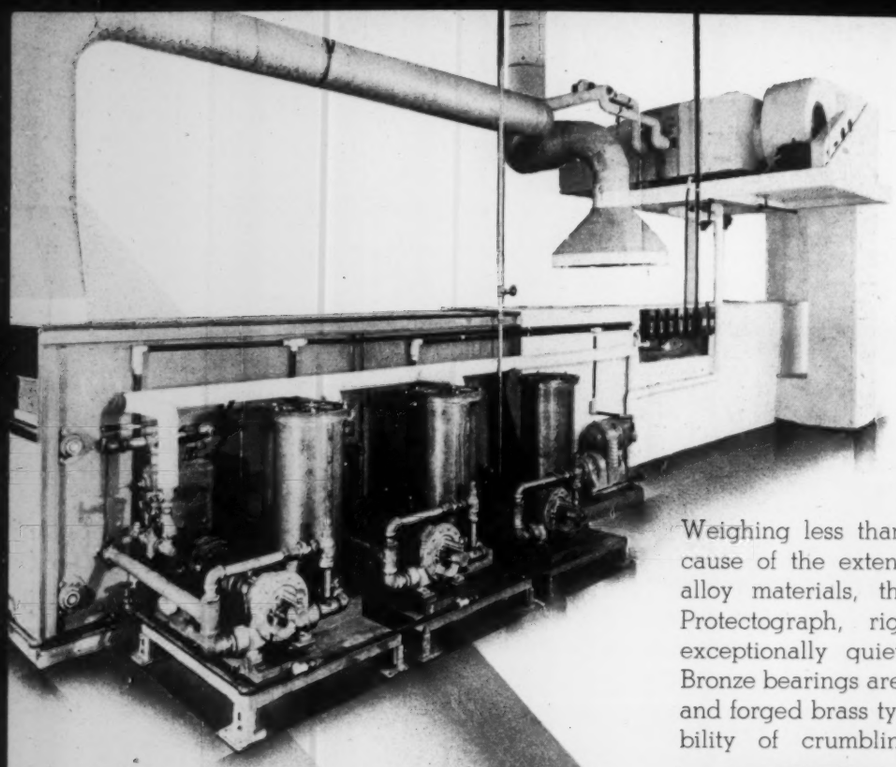
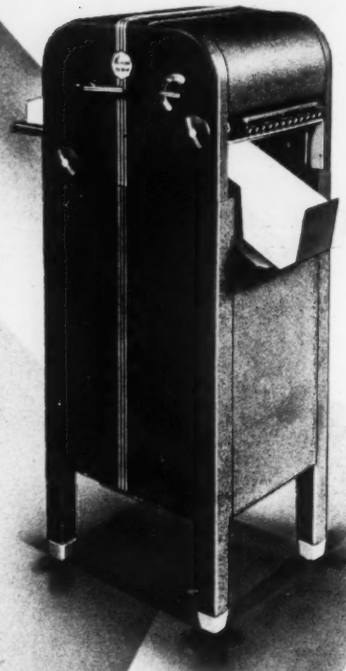


Fig. 6—At left is a heavy press in which weight of slide, die, etc., is counterbalanced by air cylinders

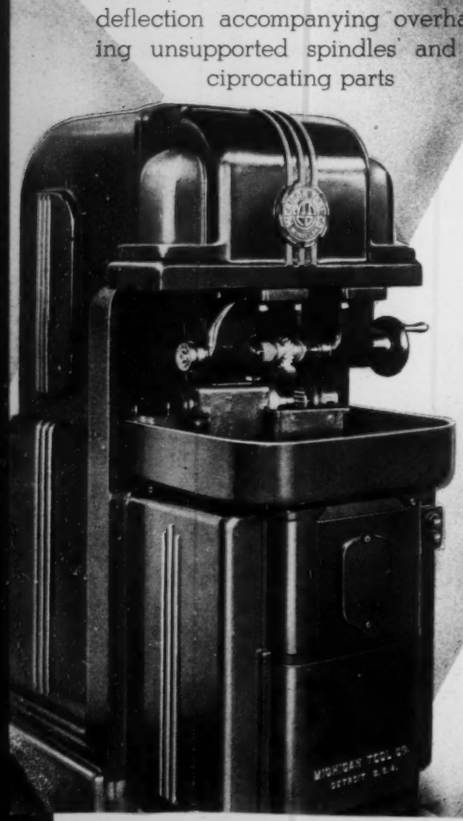


Infinite number of conveyor speeds for different bottle sizes is possible in the U. S. Bottlers washing and drying machine, above, by use of variable speed unit with built-in motor. Three turbine pumps supply hot water at high pressure for washing. Drying tunnel is insulated with corkboard; asbestos insulates inlet and outlet ducts

Weighing less than 30 pounds because of the extensive use of light alloy materials, the Todd electric Protectograph, right, incorporates exceptionally quiet driving motor. Bronze bearings are used throughout and forged brass type reduces possibility of crumbling or chipping.



Completely built into machine, a three - horsepower motor drives spindle in the attractively styled Michigan Tool duplex gear finisher' below. Cutter is mounted on table in such a manner as to eliminate deflection accompanying overhanging unsupported spindles and reciprocating parts

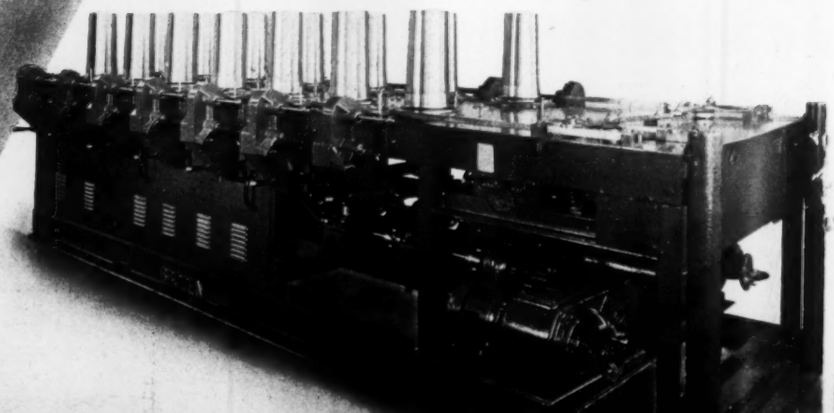


Timer built into Landis hydraulic chuck grinder, below, regulates the length grinding cycle. Work is ejected f expanding collet by solenoid-opera fingers, enabling operator to insert r piece quickly. To bring machine quick stop as a safety precaution, mo ment of single lever will momen.la reverse all movements

Design Featu In New Mach

With Particular Reference to A tion of Drives and Contro

Covers are removed on the Broden fine wire spooling machine, below, to show variable speed drives which give constant peripheral speed by slowing spindle as wire coil increases. Welded construction is used throughout machine. Fourteen spindles operate simultaneously



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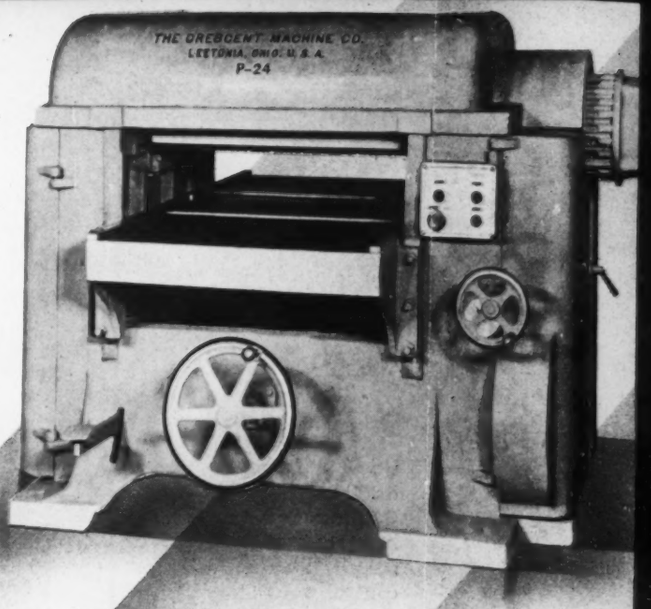
Furnished in black crinkle and highlighted with nickel brass strips, the Addressograph - Multigraph duplicator, below, combines utility with modern styling. Lubrication of important bearings is accomplished by oil tubes, easily accessible to operator. Gear drive is used from fractional horsepower motor to operating mechanism



Finger tip control station is conveniently mounted on front of Crescent planer, above. The machine is totally enclosed and all guards are aluminum; entire frame is a single piece casting of semisteel. Feed is driven by variable speed unit giving speeds of 20 to 60 feet per minute

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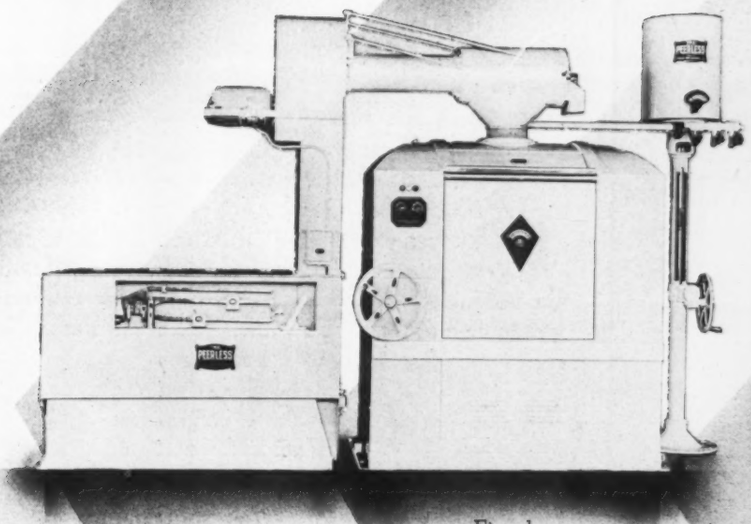
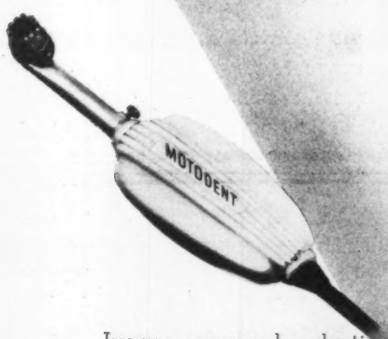
Controls

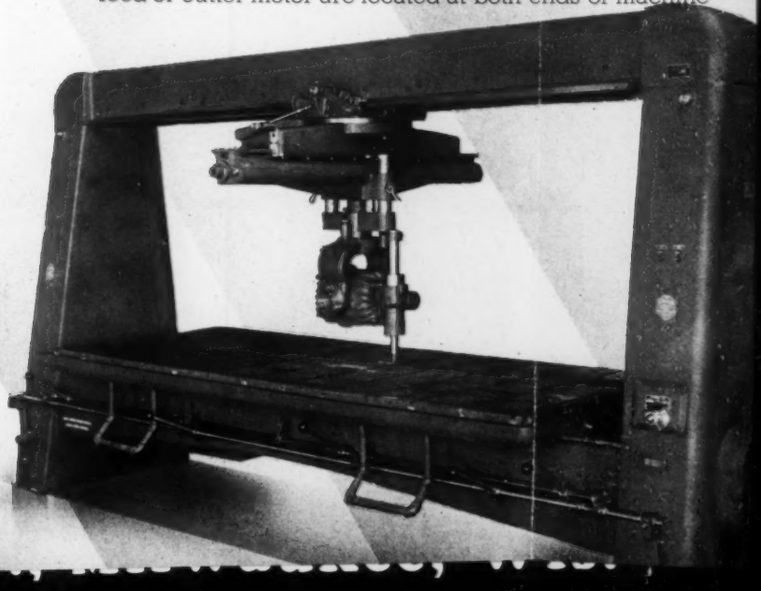


Differential countershaft directly connected to electric motor gives even distribution of power to blending and sifting unit and dough mixing unit of the combination Peerless bread making machine, left. Double automatic timer causes machine to operate for predetermined time at slow speed, then shift to high

Five-horsepower motor drives pump for supplying hydraulic power to fluid motor for operating feed mechanism on the Fay & Egan universal cutting machine, below. Pushbuttons for starting and stopping feed or cutter motor are located at both ends of machine



Ivory - covered plastic case houses tiny fractional horsepower motor in the Motodent mechanical toothbrush, above, oscillating the brush 7200 times a minute. Lubrication of motor is not necessary as oilless bearings will last for the life of the mechanism



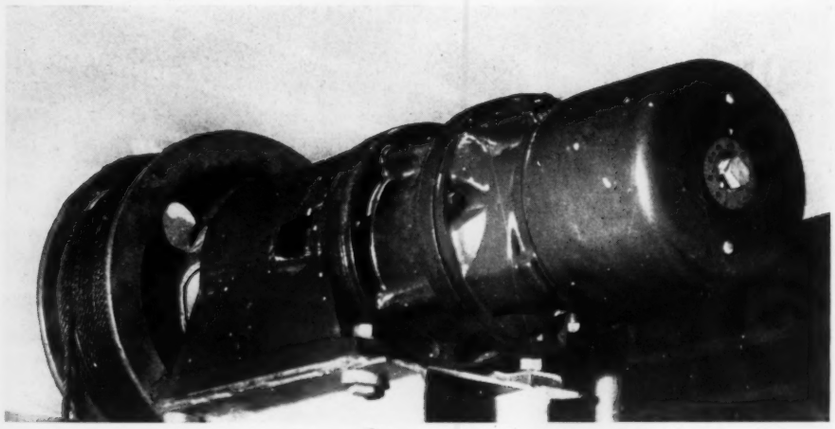


Fig. 1—An electrically actuated disk brake, mounted on the high speed shaft of this gear - motor operated hoist, affords quick, safe and simple means for remote control of stopping and lowering

Electric Clutches and Brakes Simplify Operation

By Guy Hubbard

QUICK get-away, high operating speed and snappy stopping are characteristics which by no means are limited to modern automobiles. They also represent a common state of affairs in connection with industrial machinery of various kinds. This trend has been developed to a considerable extent by demands for higher production (including less non-productive time) per machine. It has been and still is the source of plenty of headaches for engineers and designers.

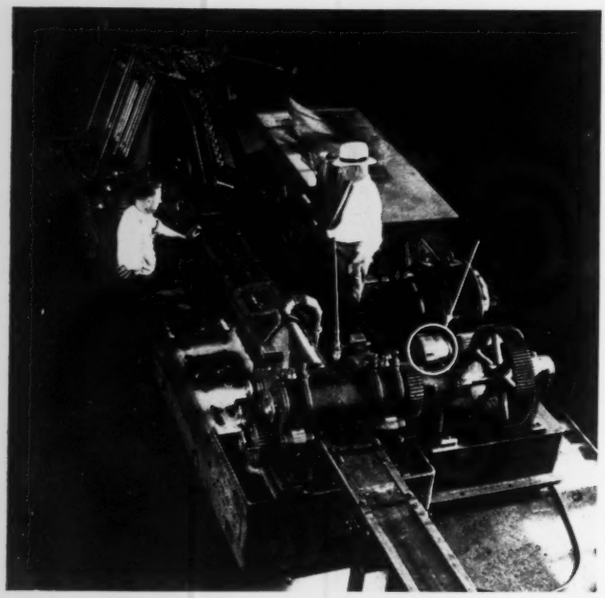
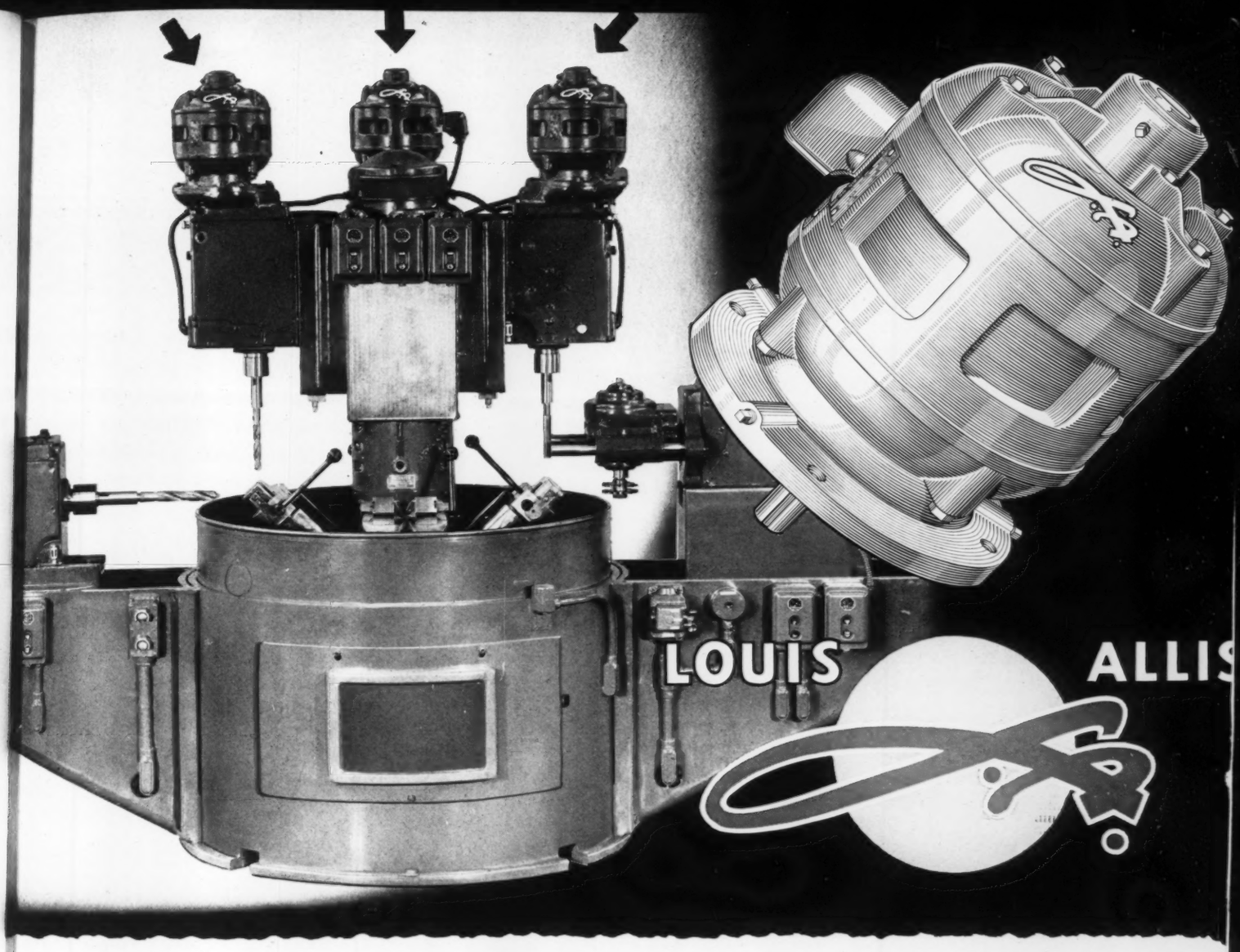


Fig. 2—On this high speed expanded metal lath machine, instant control from several points is vital. Magnetic clutch, indicated by circle, solves the problem

Electrical drive and control are potent elements in making possible the practical and safe operation of machinery at high speeds. Hence the subjects of electrical clutching and braking deserve attention. They are as important in connection with high speed industrial machinery as is compressed air control in connection with the operation of high speed railway trains. To carry this railway analogy still further, it is worthy of note that electrical clutches and brakes often are very important factors in giving to the operator of an industrial machine the same advantage that the locomotive engineer enjoys—that of instantaneous and exact control from the operating position with minimum of physical effort.

While it might seem that electric motor drive would do away to a considerable extent with the need for clutches and to some extent with the need for brakes, the fact is that new needs have been introduced which counterbalance any elimination of these elements through direct drive. This is due to the fact that where speed is increased inertia also increases.

To make possible extremely quick starting and quick stopping of elements in modern machinery it therefore becomes necessary in many cases to have



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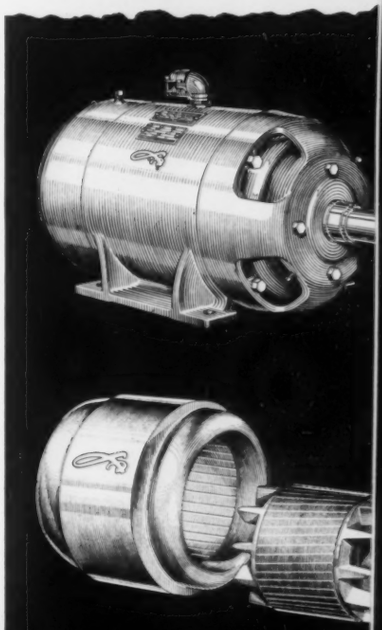

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certain of these elements "connectable" and "disconnectable" from all possible "flywheel effect" such as that of a motor armature or a train of gears. That is where compact clutch-brake combinations serve an especially useful purpose. Consider for example a threading attachment in a high speed automatic machine tool of multiple-station type, which sometimes must be set to run a die close up to a shoulder or a tap almost to the bottom of a blind hole in the work.

Various Systems Are Used

There are a number of recognized systems of electrical clutching and braking. Common methods are to actuate friction bands or friction plates either by built-in electromagnets, as in *Figs.* 1, 2 and 3; to actuate them by exterior magnetic units (solenoids particularly) operating either directly or through linkage, as in *Figs.* 5 and 6; to actuate them by torque motors (motors which can be driven to "stall" and held there with current on); or by hydraulic thrust mechanisms energized by motor-driven pumps. In some of these mechanisms engagement of the friction elements is by spring pressure while disengagement is by electrical power—this being true particularly of brakes, as illustrated by *Figs.* 1 and 5.

Another system is through direct magnetic effect. An interesting example of electromagnetic clutching was at one time furnished by the Owen Magnetic automobile, in which field magnets and an armature respectively replaced not only the external and internal cone clutch elements but eliminated the change gear mechanism as well. While this system has disappeared for the time being at least from the automotive field and is not illustrated in this article, it has definite design possibilities in a number of directions.

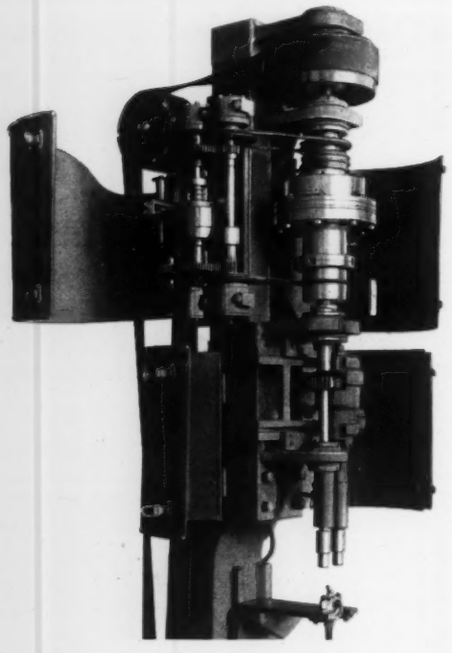

Fig. 3—Nut driving machine, guards open to show 10-inch magnetic clutch controlling drive

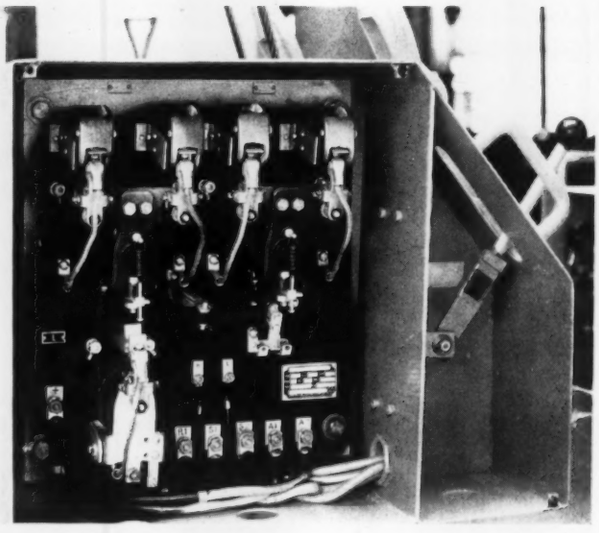

Fig. 4—Hoist control panel on an electric truck, through which dynamic braking can be effected

The use of the driving motor itself as a powerful magnetic brake is a method which effectively has solved many difficult problems. This technique was dealt with to some length in the article, "Does All-Electric Milling Machine Indicate New Trend?" which appeared in the June, 1936 issue of MACHINE DESIGN; it is mentioned by A. L. Krause in the lead article in this Supplement; and also is dealt with in connection with *Fig.* 4 which appears herewith.

Without going into great detail as to the design of the units themselves, the thoughtful attention of designers is called to the illustrations which accompany this article. Not only do these show successful applications of systems of various kinds, which should inspire many other applications, but also they suggest further applications of solenoids in connection with operation and control of machinery.

Disk Brake Controls Hoist

The mechanism shown in *Fig.* 1 is a General Electric power and winding unit for hoisting milk cans in a creamery. It consists of a gear-motor with a cable-winding drum mounted directly in its low speed shaft, while on its high speed shaft is mounted a disk brake. The object of this brake, which is housed in the casing in the foreground, is to hold the load and to control its lowering, this under remote control.

An unusually interesting machine designed for making expanded metal lath is depicted by *Fig.* 2. Strip metal, fed into the front of the machine, passes first under a rotary cutter which punches it, thence into an expander (indicated by the operator's left hand) where stretching takes place, and finally through leveling rolls at the far end. An important part in the operation of this intricate machine is played by a

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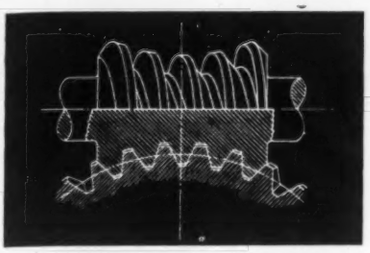

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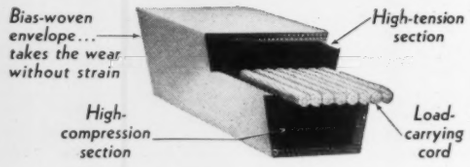

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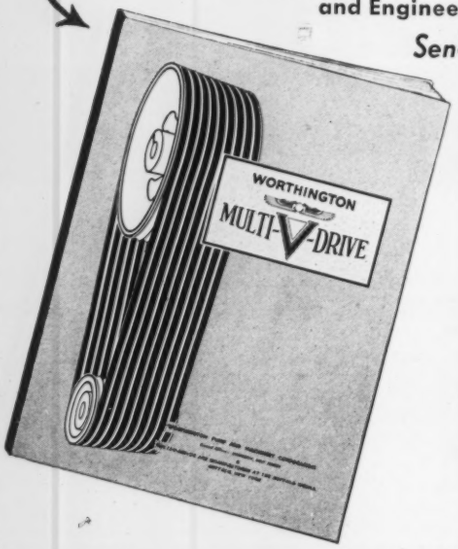

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Another interesting magnetic clutch application is shown in *Fig.* 3. This is a nut-driving machine, the operation of which is made clear by the set up which is illustrated. Built into its driving mechanism is a 10-inch Cutler-Hammer magnetic clutch by means of which release is effected when tightening has been done to the correct degree.

Mention already has been made of braking through the motor itself. *Fig.* 4 shows an example of a control through which this is accomplished on the hoist of an Elwell-Parker electric truck. This hoist-controller-contactor set up, a development of the Clark Controller Co., consists of interlocking reverse switch and two auxiliary contactors. When hoisting the load the hoist motor operates as a straight series motor. When it is reversed to lower the load it functions as

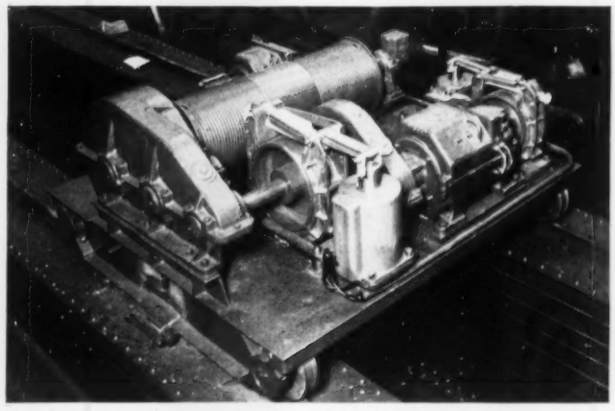
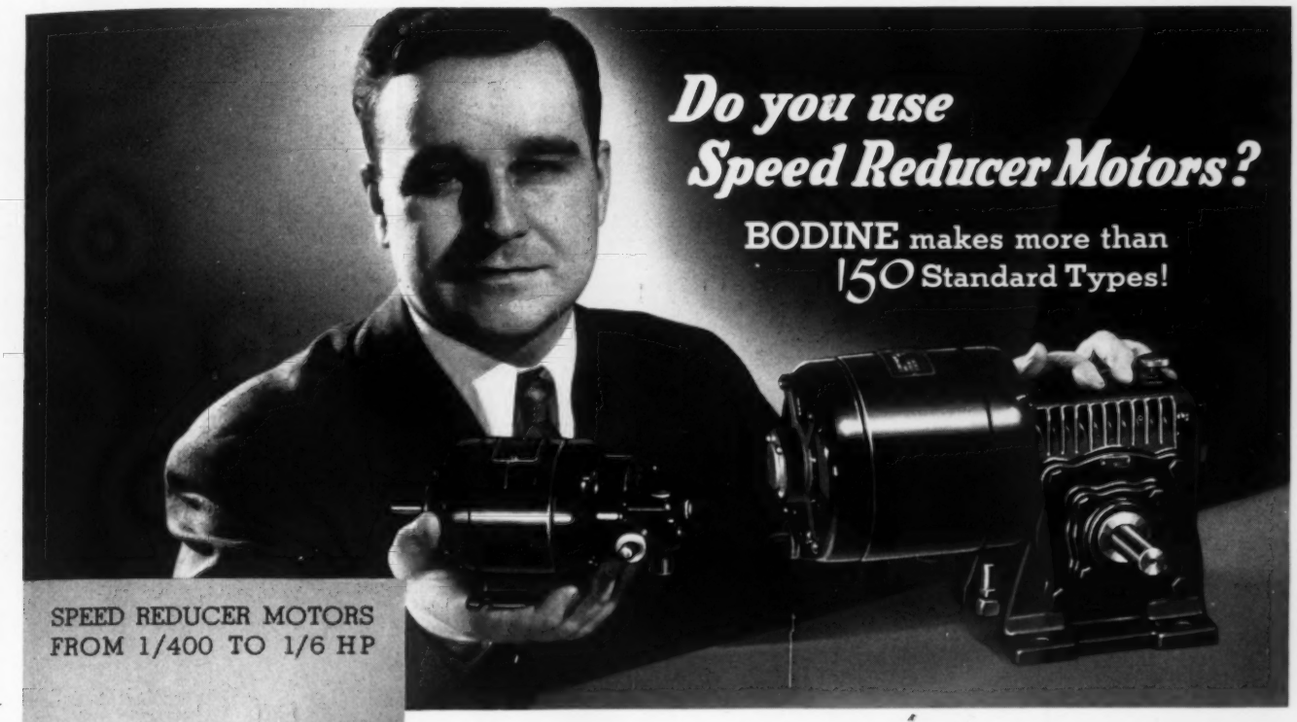


Fig. 5—Solenoid released brakes are dual safety feature on hoist trolley of overhead traveling crane

a compound motor. When the delayed time contactor closes the series field is short-circuited and if there is no load on the ram the motor continues to lower as a shunt motor. However, if the ram is descending under load the load becomes a source of energy, converting the shunt motor into a shunt generator, thereby charging current of considerable value back into the storage battery.

Magnetic brakes are particularly useful in the crane industry. Consider for instance applications on the hoisting trolley of the overhead traveling crane shown by *Fig.* 5, designed and built by the Shaw-Box Crane & Hoist division, Manning, Maxwell & Moore Inc. Being direct-current operated, this mechanism has two magnetic brakes—one on the armature shaft of the motor, the other on one of the intermediate shafts of the hoist drive. The brake on the interme-



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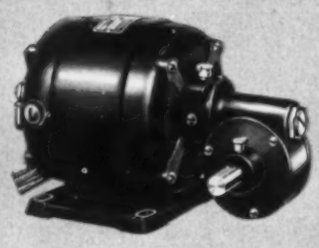

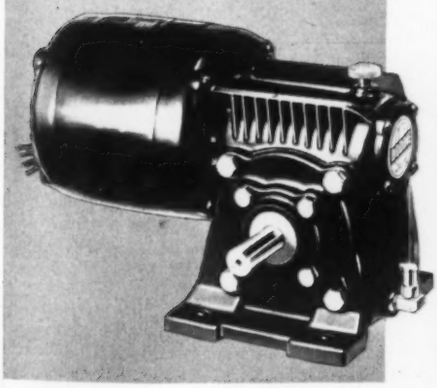

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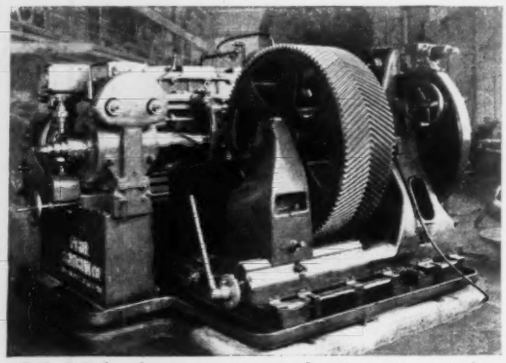
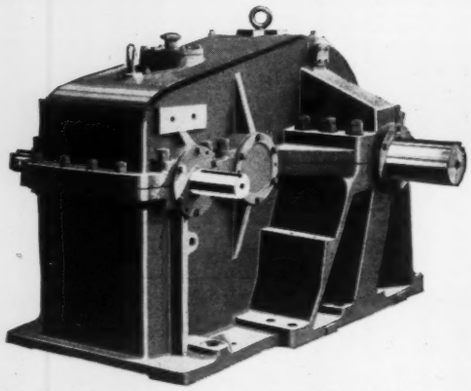


GEARS of continuous tooth type, give greater strength . . . extra load carrying capacity for heavy service at high speeds.

HOUSINGS are sturdy, compact, oil-tight, with positive lubrication to all moving parts.



ECONOMICAL, power saving, long lasting, need little care, low up-keep.

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Industrial Gears and Speed Reducers

ERIE AVENUE AND G STREET, PHILADELPHIA

diate shaft is an additional safety feature. While no mechanical load brake is used on the feed train, this extra magnetic brake makes it possible safely to remove the armature of the motor while load is suspended from the crane hook. As is obvious from the illustration these brakes are powered by exterior solenoids.

Solenoids Have Wide Possibilities

Speaking of solenoids, they can well be considered as effective, compact and economical power units for many "pulling" services such as throwing levers. An example of this is shown in the unit depicted in *Fig.* 6, which embodies one of the small solenoids manufactured by the National Acme Co. In this particular instance the solenoid is employed to operate a brake on the chucking mechanism of a Gridley multiple-spindle chucking machine. It replaces a mechanical system which involved cams and has been found to be quicker, more positive and more dependable. While the use of solenoids to operate valves already is common practice and their usefulness on brakes is becoming equally well recognized, there still remain numerous possibilities for these units in the realm of machine design.

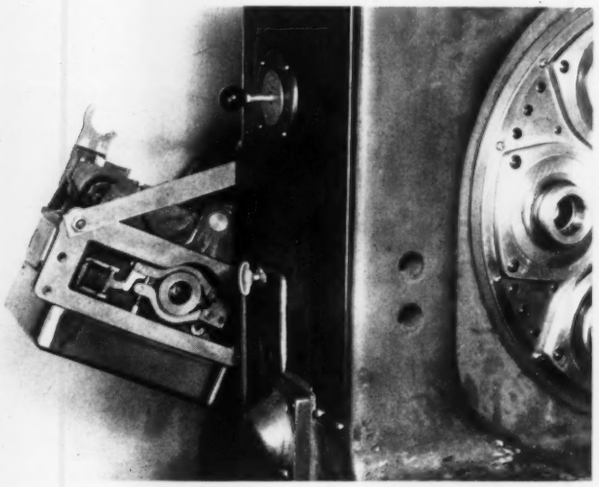

Fig. 6—Small solenoid unit has replaced cam device for operating brake on automatic chucking machine

As is true of motors, and also of magnetic clutches and brakes, a wide variety of solenoids ranging from small units like that just described to large, powerful units such as those shown in *Fig.* 5, are now commercially available. Designers should think of them as "straight line motors" which will respond instantly to contacts either manual or automatic anywhere in or on the machine or even far distant from it. Remember that these units can be supplied to give a pull of a definite number of pounds over a definite number of inches. Therefore, within reasonable limits, they readily can be selected to fit into a design.

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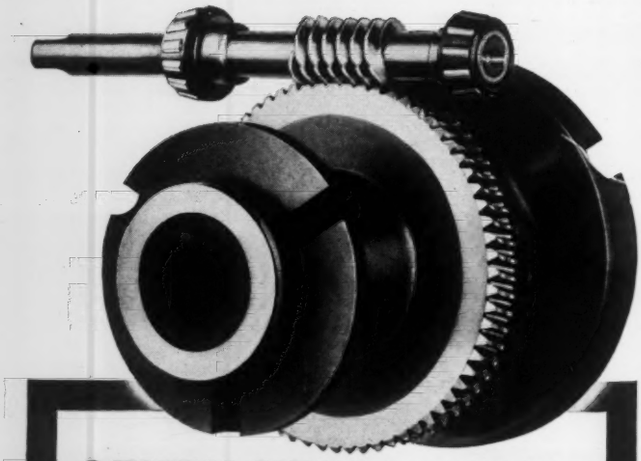
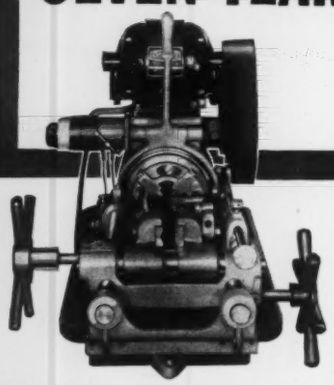


SEVEN YEARS—SAME GEARS



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OHIO GEARS

Ingenuity Is Displayed In Electric Controls

(*Continued from Page 57*)

with the reduction to 7 inches per minute obtained by armature control.

Adjustable speed motors are, however, either physically large if a low basic feed is used, or if a high top speed is used the same condition of high stored energy is encountered. This high stored energy limits rapidity of reversal. At the same time necessity for accelerating to top speed with a weak motor field would make reversing action sluggish and give rise to commutation difficulties. Such a motor would require a starting resistance with accelerating contactors, etc.

Factors Determining Final Choice

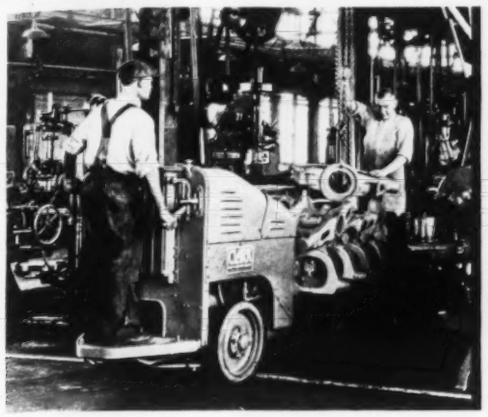
The variable voltage-controlled, direct current motor system has the disadvantage of requiring a separate generator, and ordinarily an additional separate exciter which in this case is unnecessary because of the headstock generator. This system is used most successfully on applications having constant torque requirements, as is the case in the table drive. It provides an ideal method of reversing, because inertia of the generator field prohibits those rapid fluctuations in current which give rise to poor commutation. At the same time action of these fields can be made fast enough to insure rapidity of reversal. Since the control reversing contactors need carry only the generator field circuit, small units can be used. Acceleration and deceleration of the table driving motor is always done with the maximum motor field, thus insuring maximum possible motor torque. This, together with the fact a low speed motor can be used, insures quick, accurate reversing.

Change Gears Give Dual Speed Range

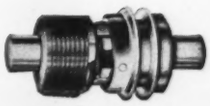
Regardless of type of motor used the range is much too wide to be taken care of electrically without expensive regulating equipment. Therefore in this application a 5 to 1 mechanical gear change is provided in addition to the provision for change in motor speed by means of voltage control. This gives two speed ranges on the motor rheostat; namely 15 to 60 inches per minute and 75 to 300 inches per minute. When operating at the low speed range, additional speeds down to 7 inches per minute may be used, the load under this condition being sufficiently light to avoid any regulation difficulties.

When operating at any speeds up to 60 inches per minute, no difficulty is encountered in securing accuracy when reversing, but on speeds of 75 to 300 inches a minute this becomes a very different

ROCKFORD INDUSTRIAL CLUTCHES

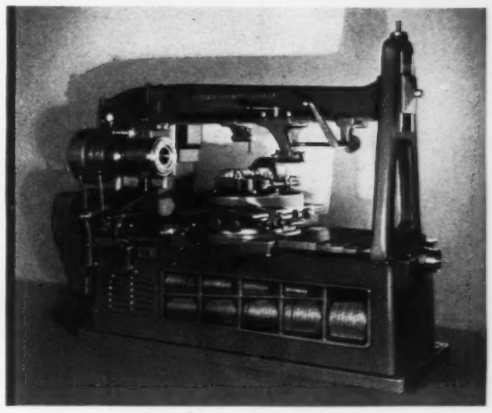


Clark Truclift



Single Type Pullmore

Double Type Pullmore



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Pullmore Clutches

Pullmore Multiple Disc Clutches are unexcelled for use in machine tools, industrial trucks, cranes and similar equipment. They are used as main drive clutches carrying all the load; as auxiliary clutches controlling individual units; and in power take-off mechanisms which operate other equipment. Compact, reliable, durable; Pullmore Clutches give highly satisfactory service throughout a long life. They engage smoothly, operate efficiently; are easily adjusted when this eventually becomes necessary; are readily adapted to machine design requirements. Pullmore Clutches are made in single and double types; for operation in oil or dry, in capacities ranging from 1 to 75 h.p. at 500 r.p.m. For illustrations of many Pullmore Clutch applications and other valuable information, write for free Pullmore Blue Book.

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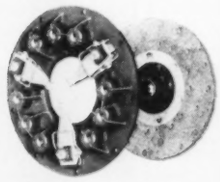
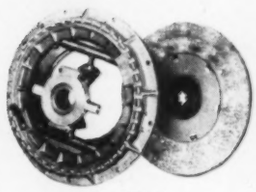
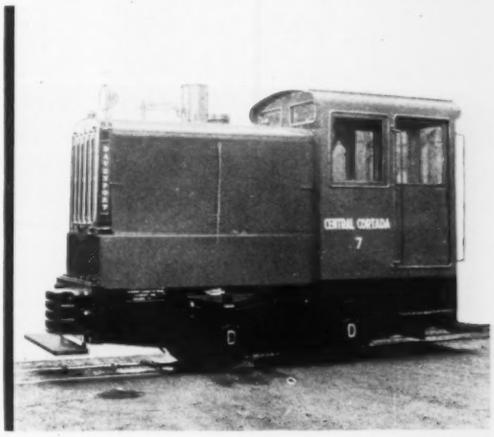


Spring-Loaded



Over-Center



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Rockford Over-Center (O-C) Clutches are notably successful in tractors, trucks, and other gasoline and diesel-engine driven equipment. Exclusive anti-friction roller cams make O-C Clutch operation extremely easy, promote long service without adjustment. These Clutches remain positively locked in or out of engagement until changed by operator. They are available with single or double drive plates, for operation in oil or dry, in sizes ranging from 7" to 20" diameter for transmitting 2 to 80 h.p. at 100 r.p.m., are interchangeable with corresponding Spring-Loaded Clutches. Write for the new O-C circular.

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Rockford Spring-Loaded Clutches operate like an automobile clutch, i.e., spring pressure holds the plates in driving contact continuously except when disengagement is effected and maintained by pressure on a lever or pedal. In general, our Spring-Loaded and O-C Clutches are made in approximately corresponding sizes which are interchangeable and have similar applications depending on service and design requirements.

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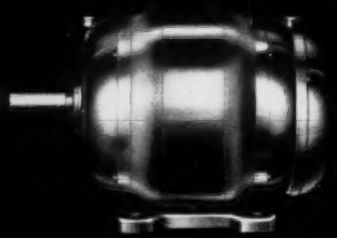

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problem. If a stopping or reversal accuracy of 1/32-inch were required with the table traveling at 300 inches a minute, this would mean a permissible variation in the operation of the devices causing the stopping and reversal of only .006 of a second, disregarding variations in friction, etc. Since this is not practical, the high degree of accuracy when stopping or reversing at speeds from 75 to 300 inches a minute is obtained by slowing down prior to reversing. The table always slows down to about the same speed and the variation in the point of reversal for different speeds thus is reduced.

Dynamic Braking Stops Table

The table when traveling, let us say, at a speed of 300 inches a minute, is first caused to decelerate to a constant slow-down speed by the action of a slow-down switch, then finally to be stopped by dynamic braking through the action of the final stop limit switch. Normally the motor immediately would start in the opposite direction, but this is prevented by the dwell relays. The dwell at the end of the table stroke is accomplished by magnetic timing relays, *Fig.* 4, which depend for their time delay on the flux decay in the magnetic circuit. This is a reliable type of timer which has few moving parts to wear. The setting of a selector switch on the front of the machine determines whether two, one or none of these relays will be effective, thereby giving a long, medium or short dwell. Intermediate timing readily can be obtained by rotation of graduated disks on the relays.

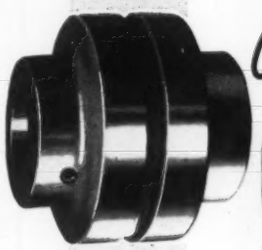
The "end stop" functions in a manner similar to the dwell in that it prevents the restart of the table in the reverse direction. It is, however, maintained until the table is started in the normal manner. When the machine is used for plunge cut grinding, this table motor acts as a cross feed drive.

Operation Controls Oil and Coolant

The oil and coolant pump units are both driven by alternating current motors, the oil pump starting and stopping with the main machine motor, while the coolant pump starts and stops with the headstock motor under normal grinding operations. In the event that the oil pump motor fails to run or if difficulty occurs in the oil line, an oil pressure safety switch automatically disconnects the machine.

The wheel slide rapid travel arrangement, normally furnished as an optional item, provides an additional 2-inch movement to the wheel slide to facilitate loading and unloading of work. This device, which can be seen at the right in *Fig.* 5, is driven by an alternating current motor through a crank motion, the slide coming against positive stops to insure accuracy. A mechanical brake is provided for holding purposes, but wear on this brake with resultant change in the

CONGRESS *Flexible* MOTOR COUPLINGS



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Congress Flexible Couplings are obtainable in six sizes for use with fractional horsepower motors or motors up to 25 horsepower and are guaranteed to be efficient, silent and low in cost.

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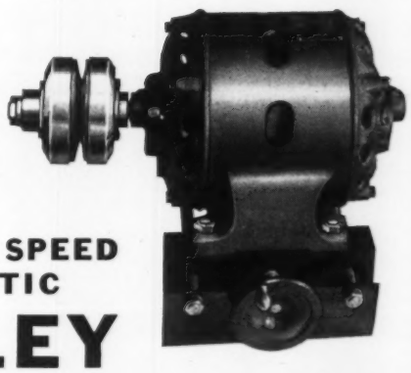

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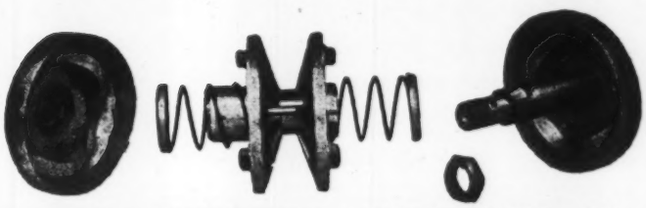

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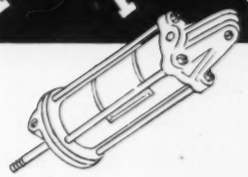

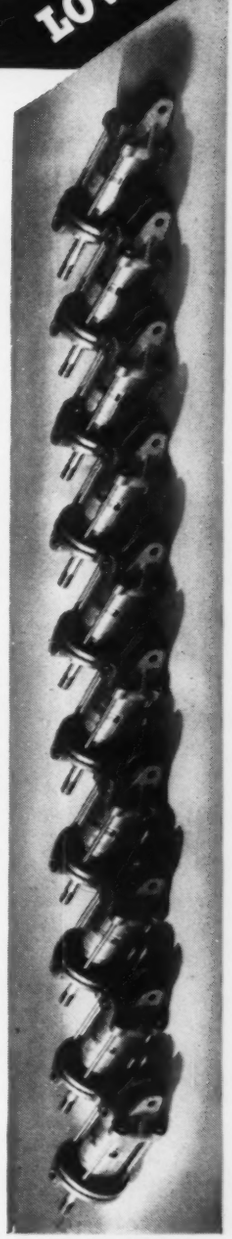

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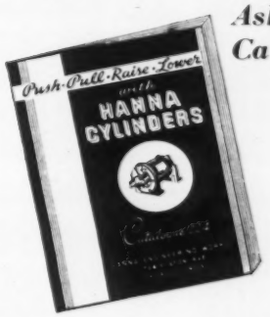
Overloading causes no problem as the cylinder will stall whereas with a positive, mechanical movement damage may result.

The cushioning effect obtainable with Hanna Air Cylinders is advantageous as jar or shock which might be troublesome is eliminated. There are few if any methods of obtaining motion which can claim to be as flexible in control, as smooth in action and as economical.



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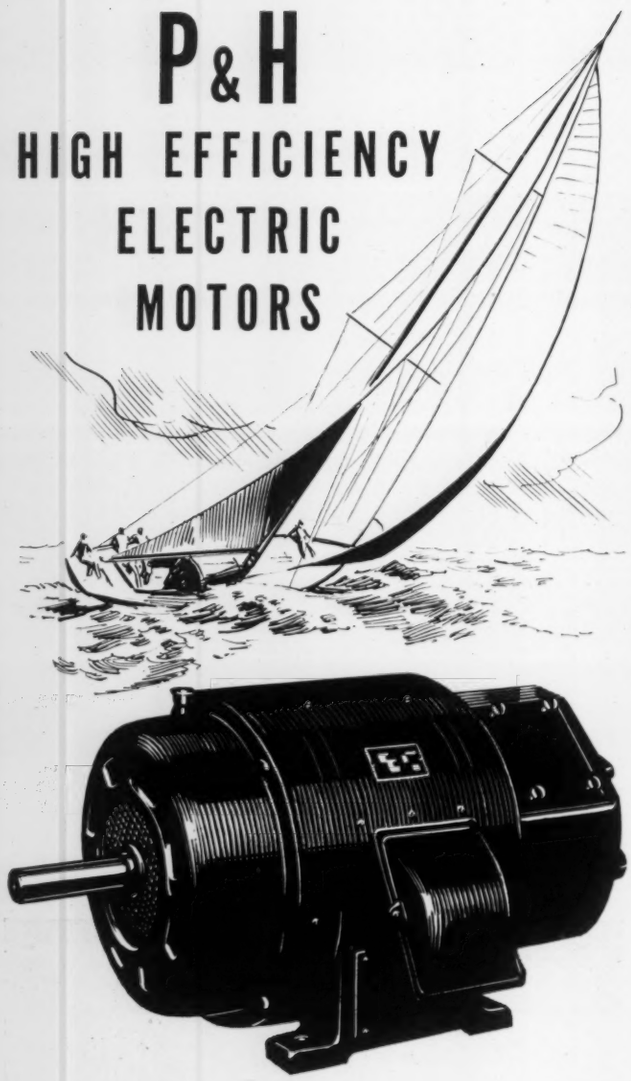

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stopping point of the motor has no effect on the wheel slide position within a certain degree of motor rotation.

With the exception of the main contactor for starting the spindle motor, all controls are supplied with direct current by the headstock generator. This insures a maximum control voltage of 230, even on those applications using 550 volt alternating current. The production problem is greatly simplified since necessity for changing controls for various voltages is eliminated. All controls are mounted within the cast base of the machine, the cast covers which are screwed to the base being fitted with felt gaskets to insure cleanliness.

Electrical System Is Amply Protected

Overload protection is provided on all motors, with resets operated from buttons carried in the cast control compartment covers. Separate fuses are provided for short circuit protection for the alternating current wiring to the auxiliary motors, and fuses are provided for protection of the headstock generator direct current circuit. The user is expected to provide the usual fused line switch for protection of the machine as a whole.

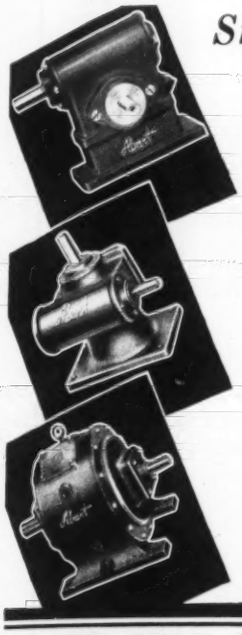
The impossibility of considering the use of standard pushbuttons, particularly those mounted in their own sheet metal cases, can well be realized by comparing the present design with one of the earlier experimental designs shown by *Fig.* 3. The three motions of the knob—clockwise, counter-clockwise, and down—give the equivalent of the three operations obtained on the ordinary 3-unit pushbutton station. Construction of the knob is such that it is impossible for coolant dripping from the operators' hand to enter the unit.

Care in Design Precludes Trouble in Service

It is worthy of note that with the exception of the main driving motor—which is limited in size because of its location—all motors and controls are completely enclosed, insuring dust-tight construction.

Despite the fact that only lubricating oil is used in this machine, it is difficult to prevent it from coming in contact with the wiring at some point or other. For this reason only oilproof wire is used between the panels and to the motors. This wire has a special synthetic insulation which withstands oil, acid, alkalies, moisture, abrasion, and flame.

For purposes of simplification, the greater part of the wiring is applied in the form of harnesses, all wires being cut correct length, provided with stamped terminals and braided together. These numbered terminals, in conjunction with correspondingly numbered terminals on the panels, make removal and replacement of parts, including the bed front plate, a simple operation which can quickly be performed without the aid of a wiring connection diagram.



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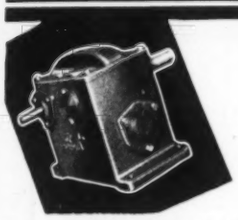

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LINCOLN TUNNEL

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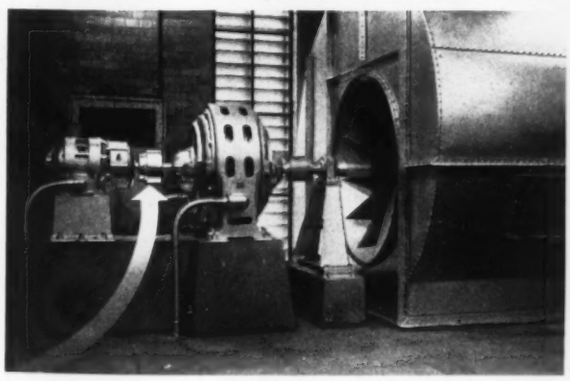

A great tribute has been paid to the Accuracy and Dependability of Hilliard Over-Running Clutches by their selection for this vital work. Hundreds are being used on equally exacting jobs. They will serve you well. For AUTOMATIC Two-Speed or Stand-by Drives. Also as Ratchets or Backstops.

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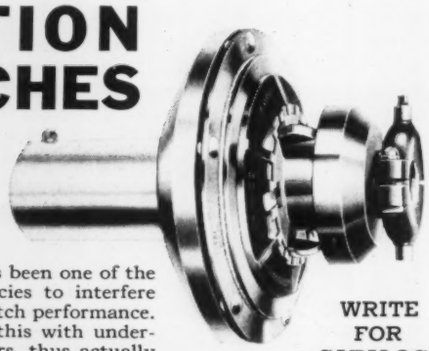

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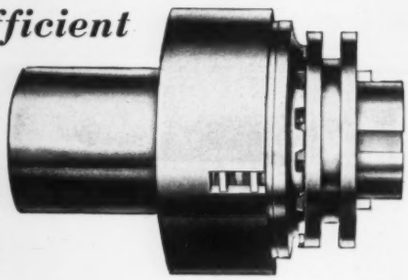

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Time Controls Are "Brains" of Machines

(*Continued from Page* 64)

justed for different periods of time are supplied now on ovens, X-ray machines, photo engraving equipment, grinders, washing machines (*Fig.* 5), baking machinery, laboratory equipment and a multitude of other machines. Operating period is easily changed by movement of a dial placed on the control panel and the machine stops when the timer trips a switch. On the grinding machine shown in *Fig.* 2 a motor-driven timer regulates the dwell period commonly called the "spark out" time. This period is the time lapse at the end of any single grinding stroke when the operator waits for the flying sparks to cease before starting another stroke. The timer controls this dwell period automatically and may be set for any length of time. A spring-driven timer for controlling the time therapeutic lamp current is on has been applied to the machine shown in *Fig.* 3. By a simple setting of the dial any period will be accurately controlled by the timer.

Greatest utility of spring and motor-driven timers is their application to process machines where

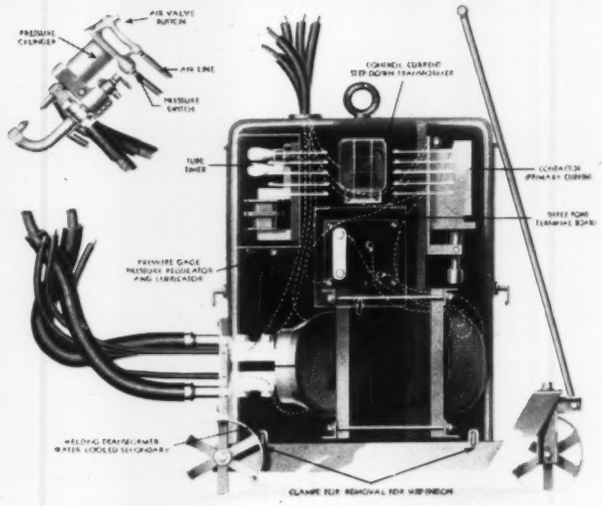

Fig. 8—Resistance welding machine employs electronic timer giving current in 1/120 of a second intervals

a sequence of operations must be timed to the second. Plastic molding machines have built-in timers to control each of the molding operations. The cycle may easily be varied by cam adjustments or in some cases by simply turning a dial. The timer is so constructed that it will repeat the entire cycle indefinitely. An interesting example of a synchronous motor-driven timer to a machine performing several operations is that of the ring gear expander shown in *Fig.* 6. The cycle of operations is initiated by

(*Continued on Page* 92)

"Mr. Cole's Swell to Work for Now!"

He Delegates Electrical Problems to G. E.

MR. COLE'S a changed man since he quit worrying about the electrical end of his machines. He's not harassed now by electrical puzzles that used to make him so hard to work for.

Like many wise machinery manufacturers, Mr. Cole has started delegating to General Electric the ***undivided responsibility*** for the electric equipment on his machines. He no longer wastes time on electrical details that used to divert his attention from bigger design problems.

You, too, will find that it pays to turn to *one* manufacturer for all your electric equipment. General Electric can furnish you with not only the wide variety of products shown in our advertisements on the following pages, but scores of other devices.

If wading through electrical details makes you want to shout at your secretary, it's time you tried letting our engineers co-ordinate your electric equipment. Just call them at our nearest sales office. General Electric, Schenectady, New York.

G-E UNDIVIDED RESPONSIBILITY GIVES MR. COLE

1. More time for other jobs he has to do.
2. The *right* motors and the *right* control.
3. The advantages of service shops for all electric equipment, convenient to all his customers.
4. Completely co-ordinated electric equipment for his machines.

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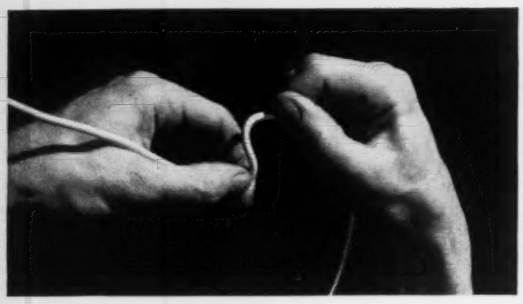
011-364

FLAMENOL

REG. U.S. PATENT OFFICE

IS TOUGH



TRY flexing this Flamenol wire back and forth as fast as your hands can go—and until they are tired. But you won't see any effect. Flamenol *is* tough.

. . . YET FLEXIBLE

You can also see how flexible it is and thus how easily it can be run around all sorts of corners.

. . . TEST IT YOURSELF

The best way to appreciate the good features of G-E Flamenol wire is to see and handle some samples. We'd like to send you a set—in several colors. You can then test them any way you want: for flexibility and toughness; for dielectric strength; for resistance to oils, acids, and water; and lastly, for resistance to flame.

For a set of these Flamenol samples, just write on your stationery to the nearest G-E sales office, or General Electric Company, Dept. 6-201, Schenectady.

INSULATED WIRE ALWAYS THE RIGHT TYPE FOR EACH JOB

New developments, such as Flamenol, are fast changing ideas as to the type of insulated cable that is best adapted for a particular product. See a G-E cable specialist to make sure of always getting the *right* type—and the most for your cable dollar.

GENERAL ELECTRIC

520-151

(*Continued from Page* 88)

pressing a pushbutton, which in turn energizes a mechanically-held relay. The mechanical relay is necessary to give positive contact closure to the clutch magnet of the timer because of the vibrations set up when the gear expander is in operation. The relay also energizes a solenoid valve to control the pneumatic elevator. When the jaws are closed the timer energizes the primary coil through a magnetic contactor for the predetermined time interval. When timed out the timer de-energizes both the solenoid valve and the magnetic contactor, thus allowing the jaws to open and the heated gear to be removed. The holding relay is opened by a momentary impulse received from the timer.

Two timers are built into the Star clothes washing machine, *Fig.* 7. One timer controls the motor of the drum in which the clothes are washed with a solvent for the required period. When the washing is completed the clothing is removed to the extractor drum where another timer controls the drying operation for the predetermined interval. The timer dials may be easily distinguished on the front of the machine.

Electronic Timers for Resistance Welding

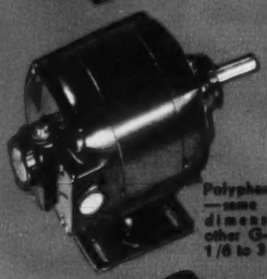
Within the last several years resistance welding has become a precision process. Exact fractional-second weld timing, as low as 1/120 of a second, is largely responsible. To obtain this precise control, electronic timing, number (7) in our modes of operation, has been introduced. By the use of an electronic tube the timer inherently operates in terms of half cycles or in 1/120 second increments of welding current. The electronic timer is designed and calibrated to apply power to the machine for a timed interval. Essentially, the electronic timer serves as a single-pole fast acting switch operating noiselessly and without the usual arc burning of contactor control. Tubes, location and size of an electronic timer in a portable resistance welding machine are shown in *Fig.* 8. Generally these timers, being of considerable size with delicate parts, are mounted on a wall close to the machine or on top of the machine away from harm's way.

Development of electronic timer apparatus now provides a definite fixed time for each weld, varying with the amount of current that is flowing. While welding, any of a number of variables may be introduced in the welding circuit and affect the rate of current flow. Voltage drop, thick material, rust or dirt and pitted electrodes are factors that require the current to be passed through the work for a longer period to obtain the same uniformity of welding.

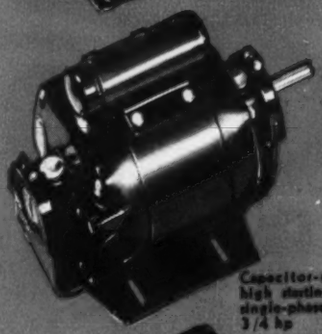
As yet there have been only a few applications of electronic timers to other types of machines, but there is every reason to believe that the character-

Small Motors

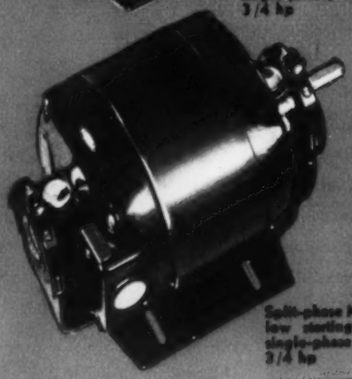
Direct-current Motors—interchangeable with a-c motors, 1/40 to 3/4 hp



Polyphase Motor—same mounting dimensions as other G-E motors, 1/6 to 3/4 hp



Capacitor-motors—high starting torque, single-phase, 1/6 to 3/4 hp



Split-phase Motors—low starting torque, single-phase, 1/40 to 3/4 hp

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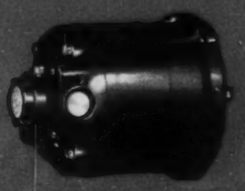
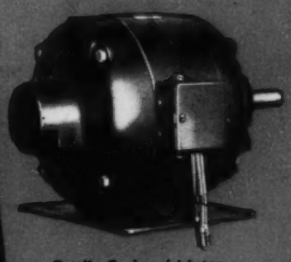


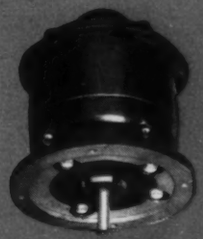
Flange-mounted Motor—for mounting on the side of a machine

Explosion-proof Motors—tested and listed by Underwriters' Laboratories, Inc.



Totally Enclosed Motors—for operation in dust-laden atmospheres

Gear-motors—compact and efficient, for shaft speeds below 600 rpm



Vertical-mounted Motors—available with ring base, flange mounting, or machined end shields

WHATEVER your requirements, the G-E line is so extensive that it includes a standard line of motors for your machines. And G-E motors will do the job. They are sturdy, and their construction embodies years of experience in building motors to help manufacturers in simplifying the design and assembly of their machines. Each has the correct characteristics for its application. Each is designed for the conditions under which it will operate—totally enclosed for dusty locations, dripproof or waterproof for wet places, explosion-proof for hazardous gas locations, and rubber-mounted for quiet operation. And you have a choice of speeds ranging from 3450-rpm, two-pole motors to 5.7-rpm gear-motors. For additional information, contact the nearest G-E sales office or write to General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

670-238

istics of this type of device, giving accurate, noiseless control will lend themselves to many machines.

The number of time control applications is legend. Wherever automatic control is used, hundreds of timer installations present themselves. More than any other control equipment, timers really make the machine a safe, self-operating mechanism.

For valued assistance in the preparation of this article MACHINE DESIGN thanks the following companies: Cutler-Hammer Inc., Struthers Dunn Inc., General Electric Co., Westinghouse Electric & Mfg. Co., R. W. Cramer & Co. Inc., Ward Leonard Electric Co., Walser Automatic Timer Co., The Electric Controller & Mfg. Co., Eagle Signal Corp., M. H. Rhodes Inc. and Allen-Bradley Co.

Range of Variable Speed Drive Increased

(*Continued from Page* 66)

added to form a balanced unit, thus reducing friction and wear.

Fig. 2 shows the final design, the gear box illustrated being part of a complicated mechanical-electrical speed control system used in a hydraulic machinery laboratory. *Fig.* 1 gives a diagram of the gear arrangement. In studying the mechanism it is simplest to consider the motion from the output shaft to the driving input shaft.

Referring to *Fig.* 1, consider first the shaft X which is always rotating at 200 RPM. On the splined shaft *A* is a gear meshing with an idler on the gear-shift handle. The idler can mesh with any one of the gears in the cluster. The cluster is keyed to shaft *X*. By moving the gear-shift handle it is possible to give eleven different speeds (including one zero speed) to shaft *A* for the one speed of shaft *X*. The same applies to the other three splined shafts *B, C* and *D*. The arm of the bevel gear differential III averages the speeds of shafts *C* and *D*. Likewise, the differential II averages the speeds of shafts *A* and *B*. The differential I averages the two arm speeds of differentials II and III.

Thus, by means of four shift levers it was possible to select any one of the more than 11,000 possible speed ratios. A 10 to 1 ratio between the two large gear clusters and the 100 to 1 ratio were used to obtain a convenient decade system. All the spur gears were from stock, 32 pitch, 3/16 inch face. The clusters were duplicates, and the differentials were almost identical. In *Fig.* 2 the largest motor connects to the input shaft. The two smaller motors connect to the differential on the gear cluster shaft but involve an electrical feature which will not be included as part of this kinematic discussion.

"Our Designers Specify . . ."

(*Continued from Page* 67)

be started. This end is achieved by a guide rail which engages the switch-operating lever at all positions except for the lowest speed. The entire control unit is built on a removable plate to facilitate inspection of the electrical contacts.

". . . . . consider first, reliability."

WM. P. BEATTIE, Electrical Engineer
The American Laundry Machine Co.

COMMERCIAL laundry machinery is designed to meet specific laundering needs and the electrical equipment used with the individual machines must be designed for the machine operating cycle necessary to take care of such needs. Washing machines for example must provide for the reception of material to be washed, the solution for washing and agitation of the work during the washing process.

The washer consists of a cylindrical metal tub for holding the washing solution, with a perforated, rotatable, ribbed cylinder inside the tub for holding the work to be washed and a drive motor connected to the cylinder and driving it through gearing, silent chain, or V-belts. To agitate the load and cause penetration of the goods by the washing solution, the cylinder movement is reversed periodically by reversing the drive motor. The controller for the drive motor incorporates a motor-driven timer which alternately energizes the magnetic contactors to cause drive motor reversals.

The machine reverses three to six times a minute and as the load has high inertia characteristics the starting and reversing motor torque must be kept low and the controller must prevent plugging of the motor. At the same time sufficient torque must be provided to accelerate the load without undue delay, which means that the motor must have special electrical characteristics, as well as mechanical structure to withstand severe service and dissipate the heat which results from frequent reversals.

The controller must insure equal movement of the machine cylinder in both directions of rotation, otherwise tangling of work and unsatisfactory washing results. A brake for stoppage of the cylinder and for holding it in position for loading and unloading against the drag of an unbalanced load must also be provided. Safety interlock switches and operating pushbuttons complete the electrical equipment used on ordinary standard washers.

With the depression a market developed for a compromise washer for the washing of linens and woolens in the same machine. The difference in technique here lies in the temperature used and the speed at which the cylinder rotates. Linens require relatively high temperature and high speed while woolens require low temperature and low speed. Therefore by

CASE STUDIES OF CO-OPERATION IN BUILDING BETTER MACHINES — No. 3

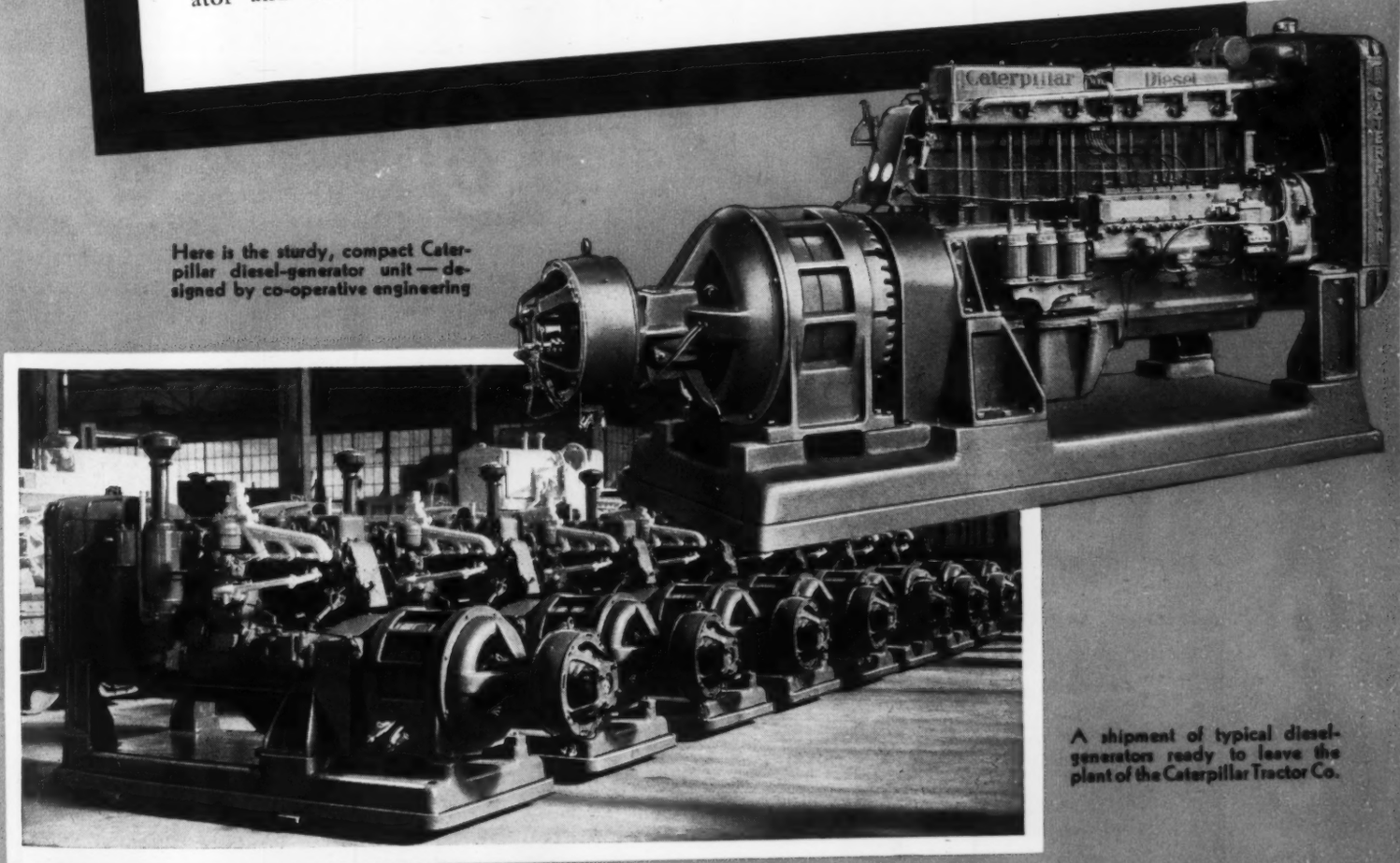
HOW *Caterpillar*

Benefits *by* Co-operative Engineering

TODAY, big shipments of diesel-generator units regularly leave the plant of the Caterpillar Tractor Co. Built to provide a dependable, low-cost source of electric power, each unit is a typical example of the hundreds of instances in which G-E engineering service has benefited machinery manufacturers.

Caterpillar Tractor Co. could see an industrial need for a compact diesel-generator set that could be built and installed as a unit. G-E application engineers went to work with "Caterpillar" designers. Together, they determined the design of a General Electric generator and exciter that would best meet the requirements of the diesels. A scheme of mounting and shaft design was selected that permitted the elimination of one bearing, making possible a perfectly aligned, space-saving unit. Many sets were built and tested until they obtained a sturdy, co-ordinated set to meet the need.

G-E engineering and testing facilities are available to you, too, for assistance in tailoring electric equipment to your machines. You can get the advantages of a more modern design, greater manufacturing economy, and ready customer acceptance of your machine by taking your electrical problems to General Electric. General Electric, Schenectady, N. Y.



Here is the sturdy, compact Caterpillar diesel-generator unit — designed by co-operative engineering

A shipment of typical diesel-generators ready to leave the plant of the Caterpillar Tractor Co.

GENERAL ELECTRIC

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020-343

You Can File It for Reference!

★

With the April issue again is presented a special Supplement, this year devoted to "Machine Drives and Controls". Addition of editorial coverage of controls enhances the value of the special section in that this aspect of design is linked closely with drive problems.

To serve readers most effectively the Supplement has been stitched separately as a composite unit, and then stapled into the center of the magazine so that it can be taken out by removing two staples without injury to the insert or to the magazine proper. This permits filing by subject to provide ready reference.

With the editorial contents written and edited to assist designers of machinery in selecting the best possible drives or controls for their conditions, the Supplement will find immediate acceptance and use. The advertising section constitutes a veritable "Where-To-Buy" Directory.

Like MACHINE DESIGN'S previously-published Directories of Materials and Special Supplements covering specific phases of design, this latest supplement adds another valuable reference work to the engineer's library.

MACHINE DESIGN

The Professional Journal of Chief Engineers and Designers

Covers every size and type of machinery--- from the "Wristwatch to the Locomotive"

designing a two-winding, two-speed, constant torque motor of proper characteristics and adding a double throw switch to the equipment, it was possible to furnish such a compromise machine without extensive changes or undue price increase.

In designing machines and associated equipment our designers consider in order of importance:

First, that reliability—as represented by continuity of service with practically no maintenance—is of utmost importance to users.

Second, that efficiency—as represented by ability to produce more work or better quality output—obviously is of real value to our users and to our organization as sellers.

Third, that—while it should be given due consideration in design—cost actually is less important than reliability and efficiency, because of the high labor costs involved in laundry processes.

". . . . . now use idler to drive pump."

M. S. LEONARD, Chief Engineer
B. F. Sturtevant Co.

IN THE oil fields power for pumping and other purposes is secured from water-cooled gas engines. Until recently it was common practice to cool the jacket water by pumping it into large open steel tanks, where its temperature was lowered by evaporation and radiation, the cooled water being returned to the engine from the bottom of the tank.

Rust from the tank combined with concentration of solids due to evaporation—water in many localities being bad—resulted in frequent clogging of water jackets, necessitating expensive shut downs.

About two years ago B. F. Sturtevant Co. conceived the idea of cooling this water with a fan-cooled radiator in a closed circuit. We developed a unit comprising an extended surface radiator of nonferrous material with large water passages, a propeller-type fan of cast aluminum alloy running on antifriction bearings, and a circulating pump—the whole being mounted on rugged base.

Drive was to be from the clutch shaft of the engine. These engines sometimes miss due to wet gas and "kick" when starting, therefore it seemed that a resilient drive would be best. Because of its cushioning effect, and ease of obtaining replacements, V-belt drive was selected. It was impractical to make either engine or cooler movable to take up the stretch of the belts, so with the endorsement of the V-belt manufacturer, a spring-loaded idler working on the back of the slack side of the belt was provided.

In this design the circulating pump was flexibly coupled to the end of the fan shaft opposite the fan, while the V-belt drove direct to the fan shaft. This drive worked but the idler literally ground the outside material off the back of the belts and they lasted only a short time. Hence we concluded that in this

WHY *Machine Operators* PREFER *G-E Push Buttons*

IT'S the push button at his fingertips that translates the machine operator's wishes into action. Hence, he's constantly conscious of the buttons he must use.

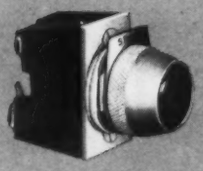
Machine operators prefer the large, easy-to-press G-E buttons and their positive feel. They also appreciate their attractive appearance when assembled on a machine.

They like the way these push buttons are suited to their job. The seven units shown here are typical of G-E built-in controls—each is designed for a particular application, hence they're easy to apply to a machine correctly.

These units can also be furnished in enclosures or on flush plates for jobs where it is not desired to build the units into the frame of the machine.

The publications shown below describe many of these stations and units. Clip the coupon *now* and obtain your copies—they show the push buttons that operators like. General Electric, Schenectady, N. Y.

New Oilproof Units

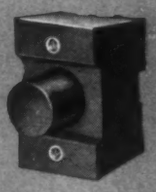


New, easy-to-mount oilproof button unit

An oilproof selector switch for any job

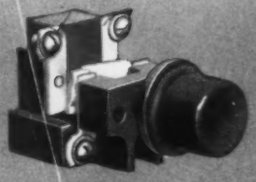
Standard-duty Units

The translucent colored button contains the indicating lamp

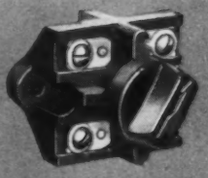


Compact panel-mounted unit is dependable and simple

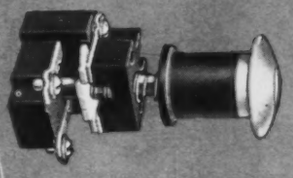
Heavy-duty Units



Large, 1½-inch button permits operation by gloved finger



Heavy-duty selector switch provides maintaining d.p.-s.t. or s.p.-d.t. operation



Mushroom-head button for emergency or frequent operation by operator's palm

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Schenectady, N. Y.

Please send me copies of publications GEA-2473 and GEA-2908 on push-button units.

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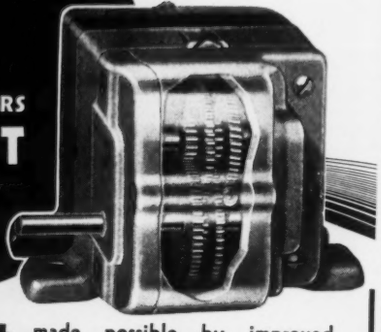

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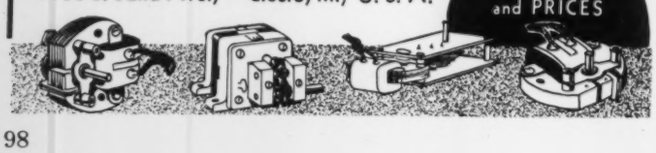

case an idler on the back of the belt was not practical.

In considering an inside idler it appeared that there would be gain in space and decrease in cost if we made the idler the driving pulley for the circulating pump, and so the final design was of that type. This has proved very satisfactory under hard service.

"..... lies in variable speed control."

J. C. WEBB
Jervis B. Webb Co.

SEVERAL years ago the Murray Corp. of America purchased from us an overhead trolley conveyor to handle automobile frames through paint drying ovens. This was about 1000 feet long, the load being suspended, and its vertical rises caused a chain pull for which a single caterpillar drive unit was of ample capacity.

In the course of time it became necessary that the capacity and length of this conveyor be increased. This involved increased chain pull of over 175 per cent in this new layout. We solved the problem very simply, all existing equipment being used and left in place and chain pull reduced below what it was at the original installation.

It was done by means of a booster drive unit. Considering the position of the existing drive unit fixed, our engineers calculated the point in the line where a booster drive might be placed so that in operation it would pull approximately half of the total load, the original drive pulling the balance.

The booster units are Webb patented floating, balanced speed control caterpillar drives. The drive frame is similar to usual structural frames used in the conveyor industry, but is placed in a secondary frame in which it is free to slide on four bronze shoes. The tendency to move as pull is exerted, is resisted by coil compression springs of sufficient capacity to keep the primary frame from sliding into a limit switch (which automatically shuts down all drives on the line) unless the conveyor is overloaded or jammed.

The trick lies in the variable speed control which automatically keeps each booster unit pulling its share of the load. This consists of a shaft extension to the adjustment shaft on the variable speed transmission. On the end of this extension is a pinion engaging a gear segment with an adjustable operating lever pivoted on a bracket, all mounted on the variable speed transmission frame. The operating lever is connected to a rod which is attached to the fixed secondary frame.

If the drive is not taking as much of the load as the springs are set for, the frame moves forward. This produces a rotation in the pinion on the speed adjustment shaft and the drive is speeded up. In like manner if the drive is taking more of the load than it is set for, the frame moves back against the springs and the drive automatically slows down.

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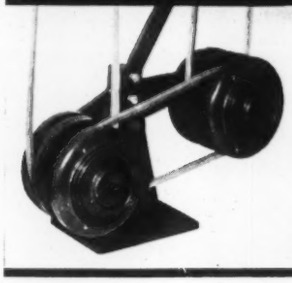

for Low Cost, Wide Range, *Variable Speed* Transmission

EXACTLY THE RIGHT SPEED for EVERY OPERATION!

From 3600 RPM down to 90 RPM, with a split hair selection of any point of speed between these wide range extremes, — that is the amazing variable power control now offered machinery manufacturers through the new Speedmaster variable speed transmission units. A speed change ratio of 40 to 1 — and the precise optimum speed needed for best results on any given operation at a simple turn of the wrist! That's what Speedmaster offers! Speedmaster units are simple, sturdy, compact, adaptable, durable, foolproof, and inexpensive. Find out at once what Speedmaster can mean to your equipment in increased versatility, efficiency and selling appeal. Send photos and blue prints for free, confidential engineering study and report. Ask for free literature.

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Division of Continental Machine Specialties Inc.

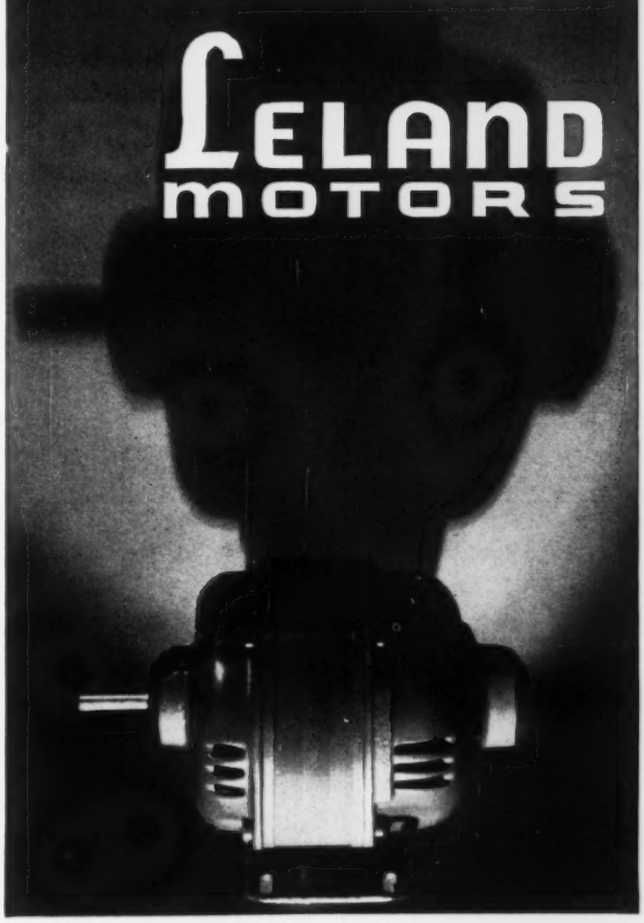
1301 Washington Avenue South, Minneapolis, Minn.

APPLICABILITY AT ITS BEST

If it is an electric appliance, there is a Leland motor ready to drive it with the efficiency and dependability you demand. Within its rating range, no line of motors is more complete or more adaptable.

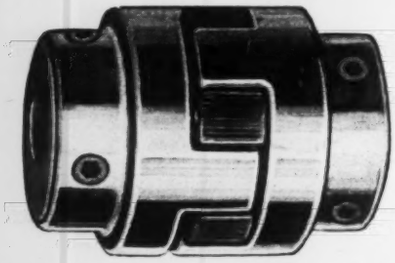
In other words, every manufacturer of an oil burner, stoker, water pump, air conditioner, or other appliance, can select from the Leland line a motor with the exact characteristics required. Get that motor and test it on *your* appliance. The Leland Electric Company, Dayton, Ohio.

More Than 200 Fully Equipped Service Stations



L-R everlasting FLEXIBLE COUPLING NON-LUBRICATED

Our Star Salesman:
A TEST SAMPLE FREE



Send us RPM, HP and Shaft Dia. for sample test coupling —$\frac{3}{16}$" to 2$\frac{1}{4}$" bore.

We send you this sample coupling with our compliments to substantiate our often repeated claim that the L-R principle supplies the operator of coupled equipment with the full and final answer to every problem that can arise.
Balance these considerations in your mind—low cost *AND* great durability; amazing flexibility *AND* max. in simplicity. In various types and adaptations ($\frac{3}{16}$" to 14" bores) the L-R principle accomplishes results no other coupling attempts. ***Give our star salesman —a free sample—an opportunity to demonstrate. Write***

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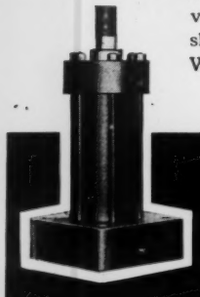
5018 WEST LAKE ST. CHICAGO, ILLINOIS

T-J HYDRAULIC CYLINDERS

- If you require Hydraulic Cylinders, Tomkins-Johnson Non-Rotating Double-Acting Cylinders will provide positive operation with maximum efficiency and trouble-free service.
- Designed for low or high pressures (up to 2000 lbs. per sq. in.) in either plain or cushioned action, T-J units may be secured in a number of styles, one of which will suit your requirement.
- Catalog No. H-37 gives complete information on T-J Hydraulic Cylinders, in addition to valuable engineering data and charts that should be in every engineer's work file. Write for your copy today.



TOMKINS-JOHNSON Company
618 N. MECHANIC ST.
JACKSON MICHIGAN

Quick Action, Safety Assured by Pneumatics

(*Continued from Page* 69)

wise have been made possible by any means.

Air driven turbines have higher speeds than electric motors or any other driving method. Much has been done in the way of high-speed grinding with saving of time and money. High-speed centrifuges are built and used with the most satisfactory results, opening new fields of research in science. *Fig.* 1 is a cross section of a M-B high speed grinder showing the relation of parts and bearing mountings. Speeds up to 100,000 RPM are possible and a grinder of this type may weigh as little as 14 ounces.

The pneumatic foundry equipment line is probably the oldest and most well known, and for very good reasons. Most foundries were equipped with compressed air before the value and versatility of this kind of power were appreciated in machine shops and other industrial plants. The characteristics of air operated equipment render it more suitable than other forms of power for foundries. The light weight, small size and the cooling effect caused by the expansion of compressed air as well as the elimination of electric wiring and extension cords on floors and near furnaces make pneumatic power especially applicable. Moreover, the higher than atmospheric pressure inside appliances that are air operated prevents admission of dust, sand and abrasives into the bearing of a machine or tool, thereby prolonging its life.

Pneumatic Devices Used on Molding Machine

A typical application of air power to a foundry machine is that depicted in *Fig.* 3 of a jarr, rollover and pattern drawing molding machine. With the operator manipulating a single valve located at a strategic position, the mold is first jarred on a pneumatically vibrated plate, the flask being firmly held by air clamps which operate instantly. When proper sand density has been attained, jarring automatically ceases and the rollover mechanism, which can be pneumatic, comes into action. Flask and pattern together are raised smoothly from the vibrator, turned over and deposited in position for drawing the pattern. This last operation is usually accomplished hydraulically, although with proper controls a pneumatic cylinder can be used. Characteristics of pneumatic equipment which make it well suited for foundry machines also have placed pneumatic road building equipment in its present prominent position.

In automotive maintenance work, air enables the use of light and extremely simplified designs to be employed for lifts, high pressure lubricating equip-

WALDRON *Flexible* COUPLINGS

a Type and Size for Every Purpose

GEAR TYPE
Medium Duty
Heavy Duty
FRANCKE
Standard
Marine
SPECIAL
Types

Most complete line of forged steel couplings for all drives, all loads. Advanced design and construction improvements insure trouble-free operation. Low initial cost. Write for catalogs giving sizes, service factors, prices. No obligation.

Manufactured by
JOHN WALDRON CORP.
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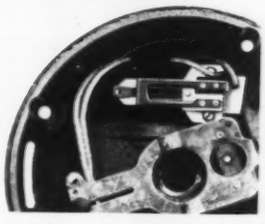
The MOTOR-COP

PROTECTS **Against Excess Temperature and Damage Caused By Stalling . . .**



Allows the motor to carry the maximum safe load under all conditions of stalling, excess temperature or extended overload. Meets Underwriters' requirements on standard fractional H.P. AC single phase motors. Is mounted within the end bell of the motor. Available in automatic or manual reset types. Can be connected for 110 or 220 volts, *without change of protector*. Your present motor manufacturer can supply you with motors equipped with MOTOR-COPS—carrying the Underwriters' label covering the combination. Make arrangements now to have the motors in your burners, stokers and pumps conform to Fire Underwriters' requirements. For complete information write—

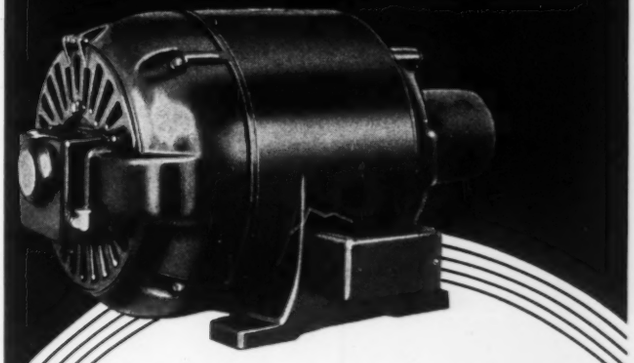
"SPECIALISTS IN SNAP CONTACTS"

MICRO SWITCH CORPORATION
13 East Spring Street — Freeport, Ill., U. S. A.

Offices in New York and Chicago

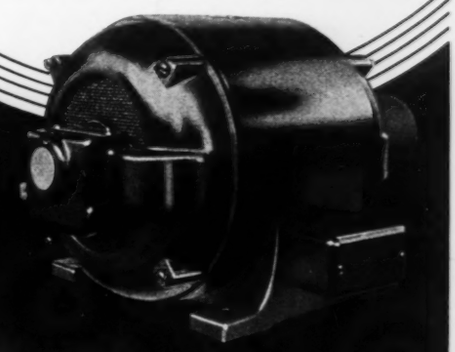
MOTORS

"That have what it takes"



IF YOU are interested in a worthwhile proposition on motors "that have what it takes" come to Peerless.

For more than 43 years Peerless has stood for quality electrical equipment and leading manufacturers of motor driven devices are using Peerless motors because they have confidence in them. They have found through test and experience that these motors carry the load with plenty to spare. *You can rely on Peerless.*



THE *Peerless* ELECTRIC CO.
WARREN, OHIO

Janette
MOTORIZED SPEED REDUCERS

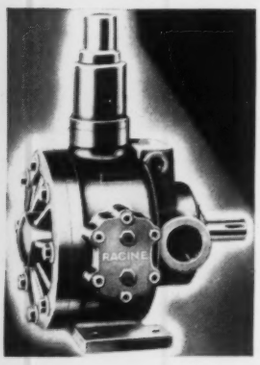
A NEW BULLETIN
For Your Reference Library

ASK FOR BULLETIN 22-25 B

In these 32 pages you will find the answer to your speed reducer drive problems. 10 types from 1/20 to 7½ H. P. from which to select.

Rotary Converters—Generators—Motors—Motor-Generators
Janette Manufacturing Company
556-558 West Monroe Street Chicago, Ill. U. S. A.
BOSTON - NEW YORK - PHILADELPHIA - CLEVELAND - MILWAUKEE - LOS ANGELES
DETROIT - SEATTLE

RACINE
Variable Volume Hydraulic Pumps



Extremely quiet, smooth performance. A thoroughly proven, efficient pump for pressures up to 1000 lbs. per sq. inch. Capacities 2000—4000—6000 cubic inches per minute.

The Variable Volume feature saves horse-power. Delivers amount of oil actually required. Volume is controlled automatically or manually.

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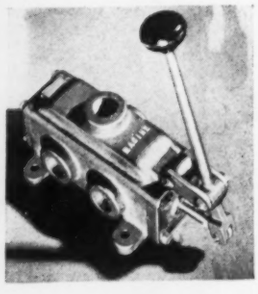

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A complete line—manual—pilot or electrically operated. Balanced pistons—Accurately fitted.
For oil-hydraulic installations.

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RACINE TOOL & MACHINE CO.
1773 State St. Racine, Wis.

ment, valve machining devices, etc. In shipyards pneumatic tools are widely used. Riveters, scalers and sanders, pneumatically driven, give exceptional service. Printing efficiency has been increased by the application of pneumatic equipment to printing presses. Paper feed, conveying and drying are a few functions that air performs or aids on presses.

Fig. 4 illustrates a National air operated projection welder with six air cylinders. The two small cylinders on either side clamp the work in place. The four large cylinders, each bringing one electrode into position, work simultaneously when air is applied. Resistance welding machines make wide use of pneumatic clamping and electrode operating devices.

Plastic molding machines and die casting machines also find air a good means of obtaining fast and positive movement. In *Fig.* 5 a Reed-Prentice plastic molding machine is shown on which two large air cylinders, one for each die, shoot the die holding plates into position and hold them while the plastic is injected. Because of the comparatively long travel and the need for fast action, air is by far the best medium that could be used for this purpose. *Fig.* 7 shows a Monarch automatic lathe in which the

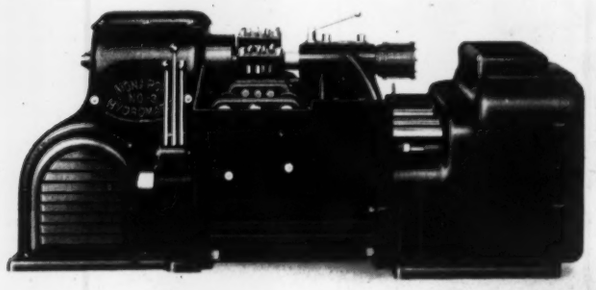


Fig. 7—To relieve operator of necessity for manually moving tailstock on automatic lathe, an air-operated cylinder is utilized

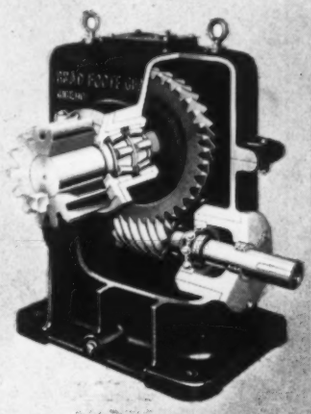
tailstock is moved in and out of place pneumatically. Air cylinders for counterbalancing the weight of slide, etc., are shown on the large Zeh & Hahnemann press in *Fig.* 6.

On small privately owned pleasure boats, air is coming to be used for engine and transmission controls. Because of simplicity of design these devices prove reliable. The small engine compressor necessary for the system is foolproof and consumes little power.

Air cylinders are light, there is little or no dirt, length of piston travel is great and action is swift, yet because air is a compressible medium it has the safety feature of not exerting an unlimited pressure.

Co-operation of the following companies in furnishing material used in the preparation of this article is sincerely acknowledged: M-B Products, The Tomkins-Johnson Co., Hanna Engineering Works, Hannifin Manufacturing Co., The Cleveland Pneumatic Tool Co. and Curtis Pneumatic Machinery Co.

Brad Foote REDUCERS



Brad Foote line in Order Shown

HEAVY DUTY WORM GEAR
single—41 ratios—3¾ to 1—to 100 to 1.—double larger

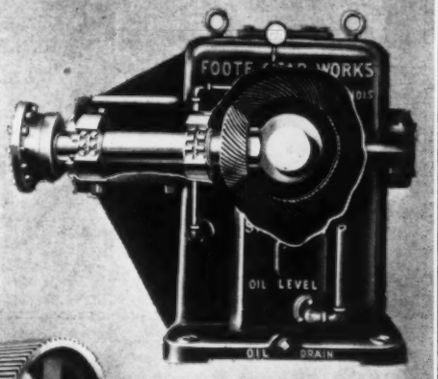
SPIRAL BEVEL GEAR
ratio 1¾ to 1—75 HP 500 RPM, constant duty, pressure lubrication

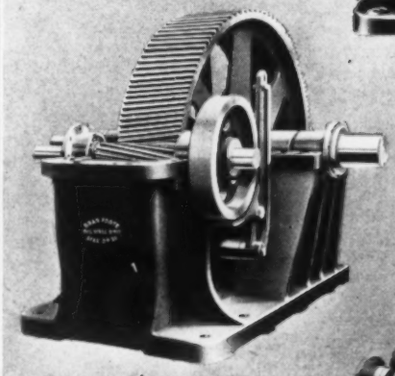
OIL WELL UNIT
single—Helical—80 HP 396,000 inch pounds torque—all types for oil fields

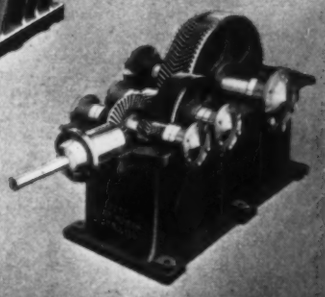
HERRINGBONE T. R. A.
triple reduction right angle—17 ratios—60 to 1 to 283.5 to 1.

Write for engineering consultation service.

Reducer Manual
Ratings at a glance — new thoughts on power transmission problems
write for it







FOOTE GEAR WORKS INC.
1301-G. S. Cicero Av. Cicero, Illinois

MACHINE DRIVES AND CONTROLS SUPPLEMENT

APRIL 1938

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By Guy Hubbard

A reproduction of Model AC4, 4 Cyl. Air-cooled engine

•

Single and 4 Cyl. models. 1 to 16 H.P.

. . . NO GREASE CUPS OR OIL FITTINGS ON THESE ENGINES

The only requirement — gas in the tank and oil in the crankcase. The engines will do the rest.

Write for specifications.

HEAVY DUTY AIR COOLED ENGINES by WISCONSIN MOTOR CORPORATION

WISCONSIN
MOTOR CORP., MILWAUKEE, WIS.

Engineer: Our Product Development Dept. has a "wow" in the making--what we need now is a vibration proof relay that will work on 800 cycles -- do you know where you can get one?

P.A: Sure thing: Struthers Dunn specializes on just such problems. I'll get in touch with them at once.

And you can't do better than getting in touch with Struthers Dunn, too, if you have a problem requiring relays!

RELAYS *by* DUNCO

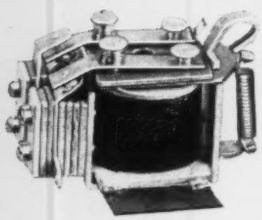
MEANS DEPENDABILITY

STRUTHERS DUNN, INC.

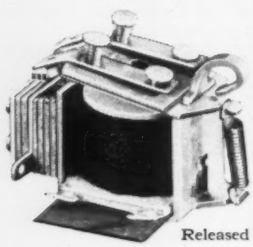
131 N. Juniper St. Philadelphia, Pa.

Never Before a Small Relay With Features Like Guardian's

NEW 150 AC 155 DC RELAY



Attract Position



Released

OFFERS advantages never before found on a small relay. Self seating spring tension contacts never change tension . . . almost never affected by vibration . . . need no adjustment. Will *not* open from jar or vibration. Contacts have full double-wiping action, either "attract" or "released". Full floating armature cannot stick in any position. Noiseless operation. Choice of several types of mounting brackets or can be mounted with one screw. Has *closed field* for maximum distribution and utilization of lines of magnetic force. Ready accessibility. Easy Wiring. Current drain approx. 2 watts. Pure Silver Contact points.

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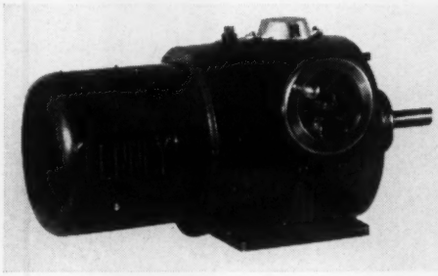

fore-thoughts

—that should govern the selection and purchase of a variable speed drive . . . and *four*-thoughts that comprise the principle of perfection in the NEW LENNEY VARIABLE SPEED TRANSMISSION.

◆ COMPACTNESS

The LENNEY V.S.T., both the unit itself and the motorized unit, embodies a design of utmost compactness—thereby permitting its use in places where most speed reducers would prove unadaptable.

◆ APPEARANCE

Simplicity of design in the LENNEY V.S.T. coupled with select materials and exacting workmanship gives it an exterior of trim, streamlined beauty that harmonizes with any piece of modern day mechanism—a vital selling factor.

◆ DURABILITY

The liberal use of ball bearings in the LENNEY V.S.T. plus a constant bath of oil to all moving parts insures *positive* and *quiet* operation over great periods of time. The absence of reciprocating parts banishes vibration—a destructive element to surrounding equipment.

◆ PERFORMANCE

In the LENNEY V.S.T. a hardened steel roller in pressure contact with an equally hardened steel driving disk is used to transmit power—thus the speed to which it is set is its running speed, no matter what the imposed load on the output shaft. Shock loads or extreme overload will not change the speed.

Write for Complete Descriptive Bulletin!

THE LENNEY MACHINE AND MANUFACTURING COMPANY

WARREN • OHIO

CUT IT DOWN *with* FORGINGS

To gain the approval of present-day buyers, equipment must be economical to operate. That often calls for the elimination of every pound of useless deadweight. This can best be done with forgings. Pound for pound, forgings are far stronger . . . much more dependable . . . permit a lighter-weight parts' design without sacrifice of structural strength. With forgings, strength is not achieved by metal bulk; but through concentration of grain structure and fiber formation at points of greatest shock or strain. Forging kneads the metal into a dense mass of durable strength; avoids concealed defects. This mechanical and metallurgical perfection provides a wide margin of tensile and torsional strength . . . permits design engineers to readily meet the imperative demand for more enduring parts . . . and less bulky equipment; and frequently at a lower parts' cost. Forgings have less metal to machine off; and with forgings uniformity of physical properties is assured after heat treating.

"Drop Forging Topics" is issued monthly, and sent free upon request. Send your name and address if you are not now receiving it, and copies will be mailed regularly.

Motor Cycle Engine Manufacturer Says: "Design must be compact and lightness of weight as well as maximum physical strength are required for overall efficiency of the completed unit. Forgings are an . . . . . essential of motor cycle construction . . . . . ."

★ ★ ★

Rock Drill Manufacturer States: ". . . . our rock drill for hard rock and tough going has six drop forging parts . . . . . We use forgings for these parts inasmuch as they are subjected to the greatest strain . . . . . forgings are stronger than our castings."

THERE ARE NO SUBSTITUTES FOR FORGINGS

DROP FORGING ASSOCIATION

605 HANNA BUILDING · CLEVELAND, OHIO

SYMBOLIC EMBLEM OF THE DROP FORGING ASSOCIATION

Preface and Contents

THIS Sixth Edition of MACHINE DESIGN'S directory of materials used in the design of machinery is presented as a supplement to the regular October issue. As customary with these reference supplements the directory is first stitched as a separate unit and is then stitched into the issue proper, thus making it readily removable without damage either to the directory or the issue.

No less than four additional sections are included in this edition of the directory. Besides numerous new listings of metallic and nonmetallic materials, and the complete revision of data published in previous issues, the current directory contains lists of producers of stampings, forgings, custom moldings and die castings; facilities of each of the companies in these classifications are given. Page numbers on which the various sections commence are:

Iron, Steel and Nonferrous Alloys	15
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Custom Molders	64

Numerals are used in both the metallic and nonmetallic sections of the directory, above each listing, to classify the properties of the materials and to aid in their selection. Where numerals are shown only on the line immediately above the tradename, all types or grades produced under that tradename possess the properties designated by the numerals. When properties vary with the grades classifying numerals appear above each individual grade to designate the three major properties of each. Additional properties are given, in many instances, in the text.

New alloys, specially-processed irons and steels, plastics and other nonmetallic engineering materials will be announced as they are developed, in the "New Materials and Parts" section of MACHINE DESIGN'S regular issues.

Copyright, MACHINE DESIGN, 1938

Iron, Steel and Nonferrous Metals Listed by Tradenames

(For listing by producing companies, and complete street addresses, see Page 43D)

A

1 - 3 4 - - - - - -

ABRASOWELD — Lincoln Electric Co., Cleveland. Arc welding electrode for providing abrasion resisting, self-hardening deposit which hardens rapidly under impact and abrasion; maximum hardness develops at surface, leaving cushion of softer metal beneath; provides resistance to abrasion in straight carbon, low alloy or high manganese steel surfaces; effective on gear and pinion teeth.

1 2 3 4 - - - - - -

ACME—Acme Steel Co. Chicago. Stainless strip steel.

1 2 3 - - - - - - -

Type 410; chromium 10 to 13.5, carbon .12 max., silicon .5, manganese .5, phosphorus and sulphur .03.

Type 430; chromium 14 to 18, balance of analysis same as Type 410.

1 - 3 4 - - - - - -

Type 302; chromium 17.5 to 19, nickel 7 to 8.95, carbon .08 to .20, balance same as Type 410.

Type 304; chromium 17 to 19, nickel 7 to 9.5, carbon .08 max., balance of analysis same as Type 410.

- - - 4 5 6 - - -

ACORN—A. W. Cadman Mfg. Co., Pittsburgh; babbitt metal furnished in ingots; brinell hardness 70 degrees Fahr. 23.8, 212 degrees Fahr. 21.8; compressive strength 12,500 lbs. per sq. in.; for bearings having reciprocating motion, subject to excessive pound or vibration.

- - 3 - - - - - - -

ADAMANTINE—Babcock & Wilcox Co., New York. Special steel castings with wear-resisting qualities and machinable surfaces; for grinding mills, mixers, conveyors, power shovels.

- - 3 4 - - - - - -

ADAMITE — Mackintosh-Hemphill Co., Pittsburgh. Alloy steel characterized by strength plus wear resistance.

1 - - - - - - - - -

ADMIRALTY BRONZE — Chase Brass & Copper Co. Inc., Waterbury, Conn. Copper 71, tin 1, zinc 28; standard alloy for condenser tubes, particularly for salt or brackish water.

1 2 - - 5 - - - - -

ADNIC—Scovill Mfg. Co., Waterbury, Conn. Copper 70, nickel 29, and tin 1; furnished in rods, bars, tubes, wire, sheets, strips and plates for stamping, turning, boring, welding, deep drawing, cold heading, and brazing; resists corrosion due to organic acids, alkalies, sulphur compounds; resists heat up to 600 deg. Fahr.; tensile strength 55,000 to 130,000 lbs. per sq. in.; recommended heat treatment, annealing, 1100 to 1300 deg. Fahr.; brinell hardness, untreated, 70 to 200; used for condenser tubes and heat exchanger tubes.

- 2 - - - - 7 - -

ADVANCE—Driver-Harris Co., Harrison, N. J. Copper 55, nickel 45; resists heat up to 1500 degrees Fahr.; thermocouple material. For application where low temperature coefficient of resistivity is required; also for measuring instruments, industrial and radio rheostats and elevator controls.

- - - - 4 - 6 - - -

AERISWELD—Lincoln Electric Co., Cleveland; arc-welding electrode; for welding of bronze, brass and copper either in manufacturing or maintenance work.

- - - - 4 5 - - - -

AGATHON—Alloy Steel Div., Republic Steel Corp., Massillon, O. These alloy steels meet demands for material of lighter weight, greater strength, resistance to shock, impact and torsional strain, and high fatigue resistance; for severe service.

- - - - - - 6 - - -

AGRICOLA—Fredericksen Co., Saginaw, Mich.; a bearing bronze of copper 70, lead 30; impurities less than .2 of 1; especially adapted for diesel engine bearings, seals, etc.

1 - - - - - - 7 - 9

ALCOA—Aluminum Co. of America, Pittsburgh. Aluminum alloys for sand, die and permanent mold castings; also available in form of plate, sheet, foil, bars, rods, wire, tubing, moldings, structural shapes, forgings, ingot, screw machine products, impact-extruded products, rivets, and pressings; grades with varying compositions to meet specific requirements.

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ALCOP BRONZE—Janney Cylinder Co., Holmesburg, Philadelphia. Copper-zinc-aluminum bronze; furnished in centrifugal castings; resists corrosion due to neutral solutions; medium abrasion resistance; tensile strength 60,000 to 73,000 lbs. per sq. in.; compressive strength 30,000 to 35,000 lbs. per sq. in.; high ductility; specific gravity .30 lbs. per cu. in.; good bearing properties; brinell hardness, untreated, 120 to 150; used for retainer rings for ball and roller bearings, printing press and engraving rolls and shells, hydraulic press liners, glands and bushings.

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ALCUMITE—Duriron Co. Inc., Dayton, O. Copper 90, aluminum 9, iron 1; for pumps, valves, pipe, fittings, bars and castings for corrosive service where a copper base alloy is preferred.

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ALCUNIC—Scovill Mfg. Co., Waterbury, Conn. Furnished in rods, bars, tubing, wire and strips (coiled) for extruding, turning, boring, rolling or expanding; copper 80, aluminum 2, nickel 1, tin 1, balance zinc; resists corrosion due to salt (sea) water; resistant to heat up to 300 deg. Fahr.; abrasion resistance medium; tensile strength 45,000 to 110,000 lbs. per sq. in.; specific gravity 8.44; recommended heat treatments 1100 to 1200 degrees Fahr. (annealing); brinell hardness untreated 60 to 200; used for condenser tubes and heat exchanger tubes.

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ALLAN RED METAL—A. Allan & Son, Harrison, N. J. Copper lead-bearing alloys; segment castings for facing pistons; bearings for turbines, centrifugal pumps, high speed grinders, etc.

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ALLEGHENY — Allegheny-Ludlum Steel Corp., Pittsburgh.

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18-8; carbon .08 to .20, phosphorus max. .025, sulphur max. .025, silicon max. .50, manganese max. .50, chromium 17.5 to 19, nickel 8 to 9; used for dairy and food processing equipment, automobile and building trim, chemical plant, household and kitchen accessories.

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Stainless 12, type 410; ("to be heat treated to specific physical properties"); also available in Stainless 12-TB, Type 403 (turbine quality), 12-NH, Type 405 (nonhardening quality), Stainless 12-EZ, Type 416 (free machining), and Stainless 12-W, Type 418. Carbon max. .12, manganese max. .50, phosphorus max. .025, sulphur max. .025, silicon max. .50, chromium 10 to 13.5; resists temperatures up to 1500 degrees Fahr.; used for automotive parts, combustion and steam engine parts, chemical plant equipment tanks, fans, blowers and furnace parts.

Stainless 46, types 501 and 502; carbon 10 maximum; manganese .50 max., phosphorus .04 max., sulphur .04 max., silicon .50 max., chromium 4 to 6; following elements may be added for increased resistance to oxidation and for improved mechanical properties: Molybdenum .40 to .60, tungsten .75 to 1.25, copper 0.5 to 1; for nonhardening characteristics aluminum .10 to .25, titanium or columbium ten times carbon per cent; adaptable for wide range of uses in the oil industry.

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Stainless 28, type 446; carbon .25 max., manganese 1.00 max., phosphorus .025 max., sulphur .025 max., silicon .50 max., chromium 23 to 30; for high temperature service up to 2150 degrees Fahr., used for furnace parts, boiler baffles, kiln lining, pyrometer protection tube, glass molds, oil still tube supports, etc.

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Stainless 17, type 430; also available in

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

modified form in Stainless 17W, Type 438, containing tungsten, Stainless 21, Type 442, containing 18 to 23 chrome. Carbon max. .12, manganese max. .50, phosphorus max. .025, sulphur max. .025, silicon max. .50, chromium 14 to 18; resists oxidation to temperatures up to 1600 degrees Fahr.; used for steel engine parts, low temperature furnace parts, fans and blowers, evaporators and chemical plant equipment.

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25-12, type 309; carbon .20 max., manganese 1.25 max., phosphorus .025 max., sulphur .025 max., silicon .50 max., chromium 22 to 26, nickel 12 to 14; resists scaling at temperatures up to 2000 degrees Fahr.; malleable and ductile; used for furnace parts, industrial ovens, kiln linings, still tube supports and pump parts.

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ALLEGHENY METAL—Allegheny-Ludlum Steel Corp., Pittsburgh.

18-8-S; stainless type 304; carbon .08 max., manganese .50 max., phosphorus .025 max., sulphur .025 max., silicon .50 max., chromium 17.5 to 19 and nickel 8 to 9.

19-9; stainless type 305; carbon .08 to .20, manganese .50 max., phosphorus .025 max., sulphur .025 max., silicon .50 max., chromium 18 to 20 and nickel 9 to 10.

19-9-S; stainless type 306; carbon .08 max., manganese .50 max., phosphorus .025 max., sulphur .025 max., silicon .50 max., chromium 18 to 20 and nickel 9 to 10.

18-8; stainless type 302; carbon over .08 to .20, manganese .50 max., phosphorus .025 max., sulphur .025 max., silicon .50 max., chromium 17.5 to 19 and nickel 8 to 9.

18-8EZ (free-machining quality); stainless type 303; carbon .08 to .20, manganese .20 to 1.20, phosphorus .17 max., sulphur .60 max., silicon .70 max., chromium 17.5 to 19 and nickel 8 to 9.

20-10; stainless type 307; carbon .08 to .20; manganese .50 max., phosphorus .025 max., sulphur .025 max., silicon .50 max., chromium 20 to 22, and nickel 10 to 12.

20-10-S; stainless type 308; carbon .08 max., manganese .50 max., phosphorus .025 max., sulphur .025 max., silicon .50 max., chromium 20 to 22 and nickel 10 to 12.

Where fabrication requires deep drawing, welding or severe cold work, Allegheny Metal 19-9 will be found superior in most cases to Allegheny Metal 18-8-S because it has less tendency to work harden and requires much more cold work to make it magnetic. Its combined chromium and nickel insures greater stability than that of Allegheny Metal 18-8-S after short time heating such as in the welding operation. The higher carbon content also produces an alloy with higher true proportional limit and tensile strength giving greater resistance to reverse bending stresses thereby reducing the tendency for fatigue failure.

When special conditions of service justify the use of Allegheny Metal with additions of columbium, molybdenum, titanium, vanadium, or other elements, such modifications of Allegheny Metal will be furnished upon request.

Foregoing metals used for food and dairy equipment, chemical equipment, household equipment, and for railroad and automotive industries.

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ALLOY No. 10—Hevi Duty Electric Co., Milwaukee. Chromium 37.5, aluminum 7.5, iron 55; for resistor elements in heat treating furnaces at temperatures of 2300 to 2400 degrees Fahr.

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ALNICO—General Electric Co., Schenectady, N. Y., and Simonds Saw & Steel Co., Lockport, N. Y. Permanent magnet alloy of high coercive force; nickel 20 to 30 per cent, aluminum 10 to 12, cobalt 3 to 5, balance iron; extremely hard and obtainable in cast form. Licensees include: Continental Motors Corp., Detroit, and Arnold Engineering Co., Chicago.

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AMBRAC—American Brass Co., Waterbury, Conn. Grade A; copper 75, zinc 5, nickel 20; used for condenser tubes, etc.

See advertisement pages 9D-12D

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AMBRALOY—American Brass Co., Waterbury, Conn. Aluminum bronze alloys for varied special uses, particularly condenser tubes.

See advertisement pages 9D-12D

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AMERICAN—American Stainless Steel Co., Pittsburgh.

Stainless steel; chromium 8 to 60, carbon over 0.12, balance mostly iron; for oil, textile, pumping machinery, and other equipment requiring a corrosion resistant, tough, hard, high strength, heat treated alloy.

Stainless iron; chromium 8 to 60; carbon 0.12 or under, balance mostly iron; for oil, dairy, laundry, textile, paper, refrigerating equipment, etc.

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AMERICAN BONDED METALS—American Nickeloid Co., Peru, Ill. Chromium, nickel, brass, copper, gold resemblance and colors bonded to base metals steel, tinplate, zinc, brass, copper and nickel silver. Available in brilliant finishes and patterns as sheets, flat strips, coiled strip and round edge flat wire. Can be supplied with gum adhered paper covering protecting prefinish in drawing and forming. For parts and trim of coin-operated phonographs, vending and game machines, toys, dispensers, hardware specialties, stoves, refrigerators, automobiles, radios, washing machines, etc.

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AMERICAN QUALITY—American Steel & Wire Co., Cleveland. Carbon steels and alloys in the form of cold rolled strip, manufacturers' wire and springs.

See advertisement page 2D

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AMERCUT—American Steel & Wire Co., Cleveland. Free machining steel in the form of cold finished bars for screw machine use.

See advertisement page 2D

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AMPCO METAL—Ampco Metal Inc., Milwaukee. Special copper-base alloys for wear and corrosion-resistant service; produced in six grades.

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Grade 12; copper 88.2, aluminum 8.6, iron 2.9, others .3; furnished in rods, bars, sheets, and plates, for hot forging, turning, boring and welding; also as sand or centrifugal castings; corrosion resistant; resists heat up to 1000 degrees Fahr.; low abrasion resistance; tensile strength 65,000 lbs. per sq. in.; compressive strength 120,000 lbs. per sq. in.; high ductility; specific gravity 7.735; good bearing properties; nonmagnetic; brinell hardness 115; for use as bushings and bearings.

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Grade 16; copper 86.2, aluminum 10.2, iron 3.3, others 0.3; furnished in rods, bars, sheets and plates for hot forging, turning, boring and welding; also as sand or centrifugal castings; corrosion resistant; resists heat up to 1000 degrees Fahr.; medium abrasion resistance; tensile strength, 75,000 lbs. per sq. in.; compressive strength, 125,000 lbs. per sq. in.; high ductility; specific gravity 7.628; good bearing properties; nonmagnetic; fair weldability; brinell hardness, heat treated, 137; used for bearings, gears, wormwheels, liners, lead screw nuts—all for heavy duty where exceptional resistance to wear is required.

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Grade 18; copper 84.6, aluminum 11.3, iron 3.2, others 0.4; furnished in rods, bars, sheets and plates, for hot forging, turning, boring and welding; also as sand or centrifugal castings; corrosion resistant; resists heat up to 1000 degrees Fahr.; tensile strength 80,000 to 85,000 lbs. per sq. in.; compressive strength 136,000 lbs. per in.; medium ductility; good bearing properties; nonmagnetic; brinell hardness, heat treated, 173; for use as heavy-duty, wear-resistant gears, wormwheels, feed nuts, bearings, welding bases and pickling equipment.

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Grade 20; copper 83.13, aluminum 12.40, iron 4.07, and others 0.4; available as sand and centrifugal castings; corrosion resistant; resists heat up to 1000 degrees Fahr.; high abrasion resistance; tensile strength 85,000 lbs. per sq. in.; compressive strength 146,000 lbs. per sq. in.; specific gravity 7.437; good bearing properties; nonmagnetic; brinell hardness, untreated, 241; for use as cams and cam rollers, welding jaws, bushings, bearings, and other wear resistant parts.

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Grade 21; copper 82.34, aluminum 13.02, iron 4.14, others 0.5; available as sand and centrifugal castings; resists heat up to 1000 degrees Fahr.; high abrasion resistance; tensile strength, ultimate, 90,000 lbs. per sq. in.; compressive strength, ultimate, 160,000 lbs. per sq. in.; ductility, low; specific gravity, 7.152; fair bearing properties; nonmagnetic; brinell hardness, untreated, 311; for use as forming and drawing dies, bushings and bearings replacing hardened steel.

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Grade 22; copper 81.67, aluminum 13.42, iron 4.41, others .50; available as sand and centrifugal castings; resists heat up to 1000 degrees Fahr.; high abrasion resistance; tensile strength 90,000 lbs. per sq. in.; compressive strength 171,000 lbs. per sq. in.; low ductility; specific gravity 7.125; fair bearing properties; nonmagnetic; brinell hardness, untreated, 335; for use as forming and drawing dies.

See advertisement page 2D

1 2 3 4 5 - - 8 -

AMSCO—American Manganese Steel Div., The American Brake Shoe & Foundry Co., Chicago Heights, Ill.

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Manganese steel; 10 to 14 manganese, 1 to 1.40 carbon, balance iron; suitable for sand casting; for power shovel dippers and teeth, rock crusher parts, dredge pumps, etc.

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Alloy F-1; 15 to 17 chromium, 34 to 36 nickel; for conveyor chain, enameling furnace supports, burner parts etc.; heat resistant up to 2100 degrees Fahr.; creep resistant at high temperatures.

F-3; 27 to 29 chromium, 0 to 3 per cent nickel; for rabble arms and blades, sintering bars, etc.; heat resistant up to 1800 degrees Fahr. where temperature changes are not wide and where high unit strength is not essential.

F-5; 17 to 19 chromium, 65 to 68 nickel; furnace conveyor pans, heat treating boxes, enameling fixtures, etc.; similar properties to F-1 and F-6, except tougher and more resistant to temperature fluctuations.

F-6; 12 to 14 chromium, 59 to 62 nickel for heat treating boxes, retorts, etc.

F-8; 20 to 22 chromium, 8 to 10 nickel; for mine water and acid pump parts, marine fittings, chemical mixer and paper mill digester parts.

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F-10; 26 to 28 chromium, 10 to 12 nickel; for heat treating furnace shafts, dampers and valves, cement kiln cooler parts, etc.; creep resistant at high temperatures.

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Nickel-manganese steel; 13 to 15 man-

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

ganese, .75 to .95 carbon, .95 to 1.20 silicon, 3.50 to 4.50 nickel; welding rod for building up austenitic manganese steel castings.

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No. 459; chromium molybdenum hard alloy welding rod for hard surfacing machinery wearing parts; deposits are 500 to 600 brinell.

No. 217; welding rod for hard facing cast wearing parts; extreme hardness and great wear resistance.

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ANACONDA—American Brass Co., Waterbury, Conn.

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Beryllium Copper; copper 97.75, beryllium 2.25, nickel 0.25; for springs, diaphragms, low duty bushings and bearings.

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"85" Red Brass; copper 85, zinc 15; pipe tube and sheet forms; particularly resistant to salt water corrosion.

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Super-Nickel; copper 70, nickel 30; seamless tubes, sheets and plates; for severe condenser tube service and resistance to salt water corrosion.

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Special Phosphor Bronze; copper 88, tin 4, zinc 4, lead 4; combines general characteristics of standard phosphor bronze alloys with free cutting qualities of yellow brass.

See advertisement pages 9D-12D

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ANFRILOY—Wellman Bronze & Aluminum Co., Cleveland. A copper-lead-tin bearing bronze for high speed, light-duty bearings and for bushings where pressure and thrust are not excessive.

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ANTACIRON—Antaciron Inc., Wellsville, N. Y.; corrosion and abrasion resistant material furnished in form of finished castings; silicon 14.5, iron 85; brinell hardness 425.

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APEX—Apex Smelting Co., Chicago. A series of zinc base die cast alloys.

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APOLLOY METAL—Apollo Steel Co., Apollo, Pa. Carbon 0.08, manganese 0.40, sulphur 0.025, phosphorus under 0.045, copper 0.25 per cent; in sheets.

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AR STEEL—Carnegie-Illinois Steel Corp., Pittsburgh. Carbon .35 to .50, manganese 1.50 to 2, phosphorus .05 max., sulphur .055 max., silicon .15 to .30, and copper .20 min. if desired; brinell hardness 200 to 250; tensile strength 100,000 to 125,000 lbs. per sq. in.; for fan blades, chute linings, conveyor troughs, and wearing plates where abrasion is encountered.

See advertisement pages 6D-7D

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ARMCO—American Rolling Mill Co., Middletown, O.

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Grade 18-8 (type 302, 304); 19-9 (type 305, 306); 18-12 (type 316); 25-12 (type 309); 17 (type 430); RA (type 434A); 13 (type 410); 17-7 (type 301X) and 27 (type 446); these can all be drawn and stamped; all machinable and weldable.

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Armco H. T.-50; high tensile steel; low carbon-nickel-phosphorus steel containing molybdenum. Supplied in sheets, strips and plates; suitable for stamping and welding.

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Tran-Cor 60; high silicon steel for distribution transformers. Grade 66; steel sheets with low core loss, for power and distribution transformers. Grade 72; a high silicon steel for large generators and general transformer work.

Intermediate Transformer; scale-free silicon steel sheet for some transformer and special applications.

Special Electric; scale-free medium steel sheet for a.c. motors and generators.

Electric; special analysis sheet for rotating machines.

Armature; steel sheet for small d.c. motors.

Field Grade; special sheet for intermittent duty fractional horsepower motors.

Radio No. 6; for applications in which superior low induction magnetic characteristics are important. No. 5; for audio transformer cores and other low induction applications. No. 4; good permeability at low induction; for chokes. Nos. 3, 2 and 1; for small transformers.

Ingot Iron; highly refined iron for magnetic cores; supplied in round and flat bar form.

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Armco Ingot Iron; highly refined iron supplied in galvanized sheet for general sheet metal work; also hot rolled annealed and cold rolled sheets, plates and strip.

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Armco Enameling Iron; highly refined iron for enameling purposes; supplied in sheets.

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ASARCOLOY No. 7—American Smelting & Refining Co., New York. A cadmium-nickel bearing alloy capable of withstanding high compression loads and high operating temperatures.

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ATLAS No. 93—Allegheny Ludlum Steel Corp., Pittsburgh. Carbon, 0.55, chromium 0.65, molybdenum 0.35; for collets, studs and parts requiring toughness in hardened condition. Oil hardening.

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AUROMET—Aurora Metal Co., Aurora, Ill. Special aluminum and silicon bronzes of several compositions.

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AVIALITE—American Brass Co., Waterbury, Conn. Copper-aluminum alloy for valve seats and guides in airplane motors.

See advertisement pages 9D-12D

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"AW" (rolled steel floor plate)—Alan Wood Steel Co., Conshohocken, Pa. Furnished in five patterns to meet flooring problems in the industrial and transportation fields; designed to withstand heaviest traffic; oilproof, crackproof, heatproof, slipproof, and noiseless.

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"AW" DYN-EL—Alan Wood Steel Co., Conshohocken, Pa. High strength steel furnished in sheets, plates and floor plates; corrosion, fatigue and impact resistant; carbon .12, manganese .60, phosphorus .085, sulphur .03, and copper .40; weldable; high tensile strength; for use in railroad equipment, trucks, buses and other automotive equipment and stationary structures.

B

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B. & W. CROLOY 2—Babcock & Wilcox Tube Co., Beaver Falls, Pa. carbon .15 max., chromium 1.75 to 2.25, molybdenum .40 to .60, silicon .50 max.; for refinery and superheater tubes.

5M; chromium molybdenum; 4 to 6 per cent chromium for oil refinery service.

9; carbon .15 max., chromium 8 to 10, molybdenum 1.25 to 1.75; semi-stainless alloy of good physical properties.

18-8S; low carbon; for high temperature work if no long heating is involved.

18-8; general purpose alloy similar to Croloy 18-8S low carbon except that for pressure service the temperature should not exceed 600 degrees Fahr.

16-13-3; austenitic type alloy similar in many respects to 18-8 and 25-20; high strength at elevated temperature—corrosion resistant.

25-20; chromium 25, nickel 20; has high strength and high oxidation resistance, also excellent corrosion resistance.

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12; resistant to atmosphere and acids; resists heat up to 1500 degrees Fahr. and when heat treated has tensile strength of 180,000 pounds; supplied in form of tubing.

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BAKER—Baker & Co. Inc., Newark, N. J. Platinum and alloys for linings, contacts, thermocouples, furnace resistors, etc.

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BEARITE—A. W. Cadman Mfg. Co., Pittsburgh; babbitt metal furnished in ingots and 50-pound pigs; brinell hardness 70 degrees Fahr.—29.1, 212 degrees Fahr.—24.4; compressive strength 15,000 lbs. per sq. in.; for rotary bearings subjected to heavy loads and or extreme speed.

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BEARIUM—Bearium Metals Corp., Rochester, N. Y.

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B-4 bearing metal; copper 70, tin 4, bearium-processed lead 26; brinell hardness 40; unusual frictional qualities; particularly suitable for bearing services not provided with ample lubrication, where loads are light and speeds high; resists corrosion due to high lead content; resists heat up to 700 degrees Fahr.; tensile strength 21,500 lbs. per sq. in.; compressive strength 9750; for bearings and slides, guides, driving nuts, piston rings and packing rings.

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B-10 high strength bearing metal; copper 70, tin 10, bearium-processed lead 20; brinell hardness 55; for ordinary bearing services, including applications involving shock loading; resists corrosion due to high lead content; withstands heat up to 700 degrees Fahr.; tensile strength 25,500 lbs. per sq. in.; compressive strength 11,800; a nonseizing, nonscoring, long life, general purpose bearing metal.

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BECKETT METAL—Beckett Bronze Co., Muncie, Ind. Several grades of high lead bronze; copper 60 to 75, tin 3 to 9, lead 16 to 35, and nickel 0 to 1; furnished in rough bars and rods (cored or solid) for turning, boring, etc.; resists corrosion due to sulphuric-hydrochloric acid solutions, and resistant to heat up to 400 deg. Fahr.; tensile strength 21,000 to 24,000 lbs. per sq. in.; good bearing properties; brinell hardness, untreated, 36 to 46; used for bearings and to a limited extent in seals, piston rings and gears.

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BELMALLOY—Belle City Malleable Iron Co., Racine, Wis. Pearlitic malleable iron, electric furnace melted and continuous oven annealed; for castings of machining quality, requiring strength and shock resistance.

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BETHADUR—Bethlehem Steel Co., Bethlehem, Pa. Steels of the designated characteristics for virtually all purposes except those calling for free

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

machining. This tradename covers 43 different corrosion resistant alloying steels adaptable for machinery in the chemical industries, oil refining, mining and metallurgy, the paper industry, the food industry, etc. The following are typical examples:

No. 302, 17.5 to 19 chromium, 8 to 9 nickel, .08 to .20 carbon.

No. 304; 17.5 to 19 chromium, 8 to 9 nickel, .08 max. carbon.

No. 305; 18 to 20 chromium, 9 to 10 nickel, .08 to .2 carbon.

No. 306; 18 to 20 chromium, 9 to 10 nickel, .08 max. carbon.

No. 307; 20 to 22 chromium, 10 to 12 nickel, .08 to .2 carbon.

No. 308; 20 to 22 chromium, 10 to 12 nickel, .08 max. carbon.

No. 403; 11.5 to 13 chromium, .12 max. carbon (turbine blading).

No. 410; 10 to 13.5 chromium, .12 max. carbon.

No. 420; 12 to 14 chromium, .12 min. carbon.

No. 430; 14 to 18 chromium, .12 max. carbon.

No. 440; 14 to 18 chromium, .12 min. carbon.

No. 442; 18 to 23 chromium, .35 max. carbon.

No. 446; 23 to 30 chromium, .35 max. carbon.

No. 501; 4 to 6 chromium, .10 min. carbon.

No. 502; 4 to 6 chromium, .10 min. carbon.

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BETHALON—Bethlehem Steel Co., Bethlehem, Pa. Free machining high chromium steel for variety of machine parts. Two typical grades are the following:

No. 303; 17.5 to 19 chromium, 8 to 9 nickel, .20 max. carbon, .15 min. or .60 max. sulphur or selenium.

No. 416; 12 to 14 chromium, .12 max. carbon, .15 min. or .60 max. sulphur or selenium.

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BETH-CU-LOY — Bethlehem Steel Co., Bethlehem, Pa. A copper bearing steel resistant to atmospheric corrosion; for jackets, covers, machine guards, oil pans, etc.

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BETHLEHEM — Bethlehem Steel Co., Bethlehem, Pa.

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Nos. 235 and 300; abrasion resistant, high-carbon-manganese-silicon steels of 235 and 300 brinell respectively; for shovels, crushers, hoppers, scraper blades and conveyors.

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Nos. 6 and 7; nickel steels containing 35 and 40 per cent nickel respectively; have low coefficient of expansion; for scientific and measuring instruments and for control equipment.

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BETHLEHEM — Bethlehem Steel Co., Bethlehem, Pa.

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Bearing steels; high carbon steels in three grades, namely; "Standard" chromium steel, "H. T. W." chromium-vanadium steel, and "Moly" chromium-molybdenum steel. All grades are processed to meet requirements of bearings for automotive and industrial service. Other uses include injector parts for diesel engines.

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Magnet steels; high carbon steels with varying chromium content, up to 6 per cent. Permanent magnet No. 1, a 6 per cent tungsten steel; Cobaflux, a high cobalt steel used for magnets in meters, telephones, magnetos and other electrical equipment.

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BETHLEHEM 88-80—Bethlehem Steel Co. Bethlehem, Pa.; chromium molybdenum steel castings with high abrasion resistance for ball mill liners, rolls, tires, bottom plates, etc.

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BIMETAL—W. M. Chace Co., Detroit. Thermostatic bimetals; a number of combinations including alloys of nickel-iron, nickel-iron-chromium, nickel-iron-manganese, pure nickel, brass, bronze, etc.; responsive to various temperature ranges and provide a wide range of deflection rates and electrical resistivities; for temperature control elements in controllers, recorders, indicators, circuit breakers, etc.

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BIRDSBORO—Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.

No. 26; high physical properties including high tensile strength; resists corrosion because of copper content; for dredge castings and other castings subject to high stress.

No. 30; resists corrosion due to its copper and .25 molybdenum content. Recommended for dredge castings and other castings subject to high stress.

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BOHNALITE—Bohn Aluminum & Brass Corp., Detroit. Light alloy of which aluminum is the base; for forged connecting rods, cast cylinder heads, crankcases, transmission cases, and parts for vacuum cleaners, washing machines, shoe machinery, etc.

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BONNEY-FLOYD—Bonney-Floyd Co., Columbus, O. Annealed, normalized and quenched and tempered carbon and alloy steels for general purposes.

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BORIUM — Stoody Co., Whittier, Calif. Tungsten carbide metal used chiefly as inserts in rotary drilling tools as substitute for diamonds.

Tube Borium and Borod; made up of steel tubing containing fine particles of Borium; used as overlays on earth working equipment.

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BOUND BROOK — Bound Brook Oil-less Bearing Co., Bound Brook, N. J. Graphite and bronze bushings, bearings and washers.

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BRASSOID—American Nickeloid Co., Peru, Ill. Brass bonded to zinc, latter serving as rust-proof, flexible and inexpensive white metal base. Available in variety of brilliant finishes and patterns, as sheets, flat strips and coiled strip for continuous feed automatic presses. Can be supplied with quick removable, gum adhered paper covering permitting drawing and forming without marring pre-finish. For toys, machinery trim and nameplates, index and instruction plates, etc.

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BRIDGEPORT COPPER AND ZINC ALLOYS—Bridgeport Brass Co., Bridgeport, Conn.

Yellow brass; copper 65 per cent, zinc 35 per cent; sheet, wire and seamless tubing for drawing, stampings, and cold heading.

Free cutting brass rod; copper 60 per cent, lead 3 per cent, zinc balance; for making automatic screw machine parts.

Low brass; copper 80 per cent, zinc 20 per cent; pale golden color; for articles requiring greater ductility and malleability than possessed by yellow brass.

Commercial bronze; copper 90 per cent, zinc 10 per cent; bronze color for manufacturing stampings and drawn items and cold headed items, for outdoor use; stands weathering better than yellow brass; copper sheet, rod, wire, seamless tubing for miscellaneous manufacturing.

Phosphor bronze; copper 92 per cent, tin 8 per cent; spring quality for manufacturing spring parts; has better spring properties than 95 per cent and 5 per cent.

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Phosphor bronze; copper 95 per cent, tin 5 per cent; sheet spring quality for manufacturing switch parts.

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BUNTING—Bunting Brass & Bronze Co., Toledo. A line of some 160 bearing bronzes including the following:

Low lead bronze alloys:

Alloy No. 27; copper 80, tin 10, lead 10.

Alloy No. 72; copper 83, tin 7, lead 7, zinc 3.

Alloy No. 124; copper 85, tin 5, lead 9, zinc 1.

Medium to high bronze alloys.

Alloy No. 125; copper 75, tin 5, lead 20.

Alloy No. 135; copper 77, tin 8, lead 15.

Alloy No. 158; copper 70, tin 5, lead 25.

Alloy No. 161; copper 63, tin, 2, lead 35.

Alloy No. 162; copper 70, tin 9, lead 21.

Hard phosphor bronzes:

Alloy No. 51; copper 86.5, tin 10, lead 1.5, zinc 2.

Alloy No. 96; copper 87, tin 10, lead 3.

Alloy No. 98; copper 88, tin 10, zinc 2.

Alloy No. 156; copper 90, tin 10.

Alloy No. 164; copper 87, tin 11, lead 1, nickel 1.

Babbitts:

Alloy No. 116; copper 6, tin 87, antimony 7.

Alloy No. 170; tin, 10, lead 75, antimony 15.

See advertisement page 53D

C

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CALITE—The Calorizing Co., Pittsburgh.

Type A; nickel-chromium-iron alloy available in the form of castings and rolled bar stock; readily machinable.

Type B; cast form only for oil refining industry.

Type B-28; available as castings, sheet and bar stock; possesses extreme stiffness at all temperatures and has corrosion resistance, high creep strength and permanent ductility.

Type N; nickel-chromium-iron in sheets, bars, castings.

Type S; malleable alloy steel; greatest utility in form of hot rolled sheets for corrosion work at moderate temperatures; may be flanged, punched or assembled by welding.

Type E; a malleable alloy steel in form of bars and sheets; not affected by weather corrosion, sulphur compounds and many organic acids and inorganic salts.

Calite-Nirosta stainless steels in cast form.

Calorized Steel—Tubes, bars, plates and pots.

1 2 - 4 - - - - -

CANNON 3½ PER CENT NICKEL STEEL —Cannon-Stein Steel Corp., Syracuse, N. Y.

S.A.E. 2315; carbon .15, manganese .45, phosphorus .04, sulphur .05, silicon .30, nickel .35; brinell hardness untreated 174; recommended heat treatment carburized at 1650 degrees Fahr. heat treated, at 1450 to 1500 degrees Fahr. oil quenched. Resists corrosion due to nickel content; resists heat up to 800 to 1000 degrees Fahr.; tensile strength 85,000 lbs. per sq. in. as rolled; for king pins, rock drill parts, air hammer parts, universal joints, bolts, shafts, studs, etc.

S.A.E. 2320; carbon .20, manganese .50, phosphorus .04, sulphur .05, silicon .03

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

max., nickel 3.50; brinell hardness untreated 174; recommended heat treatment carburized at 1650 degrees Fahr., heat treated at 1450 to 1500 degrees Fahr.; resists corrosion due to nickel content; resists heat up to 800 to 1000 degrees Fahr.; tensile strength 90,000 lbs. per sq. in. as rolled; for uses same as S.A.E. 2315.

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CANNONITE—Campbell, Wyant & Cannon Foundry Co., Muskegon Heights, Mich. Electric furnace high test cast iron; total carbon 2.75 to 3; for diesel and auto cylinders, centrifugal sleeves and brake drums, gas-tight castings, presses, dies, etc.

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CARBOLOY—Carboloy Co. Inc., Detroit. A cemented carbide that has high resistance to abrasive and corrosive wear; Rockwells as high as 93 on the A scale; for wear resistant inserts to impart longer life to parts such as cams, cam followers, hydraulic valve stems and seats, machine tool rests, etc.

1 2 3 - - - - - - -

Another type in which formula varies according to use embodying tungsten carbide, titanium carbide and cobalt; outstanding on account of its extreme hardness, compressive strength being as high as 890,000 lbs. per sq. in.; Rockwell hardness on "A" scale 87 to 92; does not rust or corrode under normal conditions; in addition to use for high-speed cutting tools, material is recommended for machine parts subject to extreme wear.

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CARBOMANG—Detroit Alloy Steel Co., Detroit. Carbon 0.9 to 1; manganese 1 to 1.10, chromium 0.40 to 0.60; oil hardening tool steel castings.

1 2 3 4 5 6 7 - -

CARPENTER—The Carpenter Steel Co., Reading, Pa.

1 2 - 4 5 - - - - -

No. 1 stainless bar steel; carbon .10, chromium 12; for valve trim, turbine blades, heat-treated parts.

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No. 2; carbon .3, chromium 13; used in fully hardened condition for ball bearings, ball check valves, cutlery, instruments, etc.

No. 2B; carbon 1.00, chromium 17; uses same as No. 2.

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No. 3; carbon .3, chromium 20, copper 1; for special chemical apparatus and scale resisting parts.

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No. 4; carbon .10, chromium 18, nickel 9; for rolled moldings, stampings, etc.; also has high ductility.

1 2 3 - - - - - - -

No. 5; carbon .10, chromium 14, sulphur .30; a free machining grade for automatic screw machine parts, valve trim, pump shafts, etc.

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No. 6; carbon .10, chromium 16 to 18; uses same as No. D-1 and No. 4.

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No. 8; carbon .10, chromium 18, nickel 9, selenium .25; a free machining grade.

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N-30; 30 per cent nickel; nonmagnetic, for electrical parts requiring special thermal expansion properties.

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Chrome magnet steel; carbon .95, chromium 3.50; for magnets in meters and other electrical apparatus.

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Presto; carbon 1.05, chromium 1.40; for ball and roller bearings.

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Silico-manganese steel; carbon .60, manganese .75, silicon 2; for heavy duty springs.

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CAST ALLOY STEEL—The Alloy Cast Steel Co., Marion, O.

- - - 4 - - - - - -

Nickel steel castings; carbon .30-.40, manganese .60 to .80, sulphur .05 max., phosphorus .045 max., silicon .35 to .45, and nickel 3.25 to 3.75; has high strength and resistance to shock and fatigue; used largely in annealed condition, although responds to heat treatment.

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Nickel chrome steel castings; carbon .35 to .45, manganese .60 to .80, phosphorus .045 max., sulphur .05 max., silicon .35 to .45, nickel 1.50 to 2.00, and chromium .60 to .75; has high strength and wear resistance.

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Nickel chrome molybdenum steel castings; carbon .35 to .45, manganese .60 to .80, phosphorus .045 max., sulphur .050 max., silicon .35 to .45, nickel 1.50 to 2.00, chrome .60 to .75, and molybdenum .25 to .45; used in parts which must be strong and hard and where size or shape prevent liquid quenching.

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Manganese molybdenum steel castings; carbon .30 to .40, manganese 1.25 to 1.60, phosphorus .045 max., sulphur .050 max., silicon .35 to .45 and molybdenum .25 to .45; used for gears, sprockets, levers, etc.

- - 3 4 - - - - - -

Medium manganese steel castings; carbon .30 to .40, manganese 1.25 to 1.50, phosphorus .045 max., sulphur .050 max., and silicon .35 to .45; used in power shovels, tractors, road machinery, etc.

- - 3 4 - - - - - -

High manganese steel castings; carbon 1.10 to 1.30, manganese 10.50 to 13.50, phosphorus .10 and under; tensile strength, 80,000 to 90,000; yield, 40,000 to 50,000; cannot be machined readily and is usually finished by grinding.

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CASTALOY—Detroit Alloy Steel Co., Detroit. Chromium 12 to 14, carbon 1.5 to 1.6; air hardening tool steel castings.

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CATARACT METAL—Niagara Falls Smelting & Refining Corp., Buffalo, N. Y. Nickel copper alloy ingot for the production of corrosion resistant castings.

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CECOLLOY—Chambersburg Engineering Co., Chambersburg, Pa.

- - 3 4 - - - - - -

A; carbon 3.00; molybdenum .50, nickel .60; shock resistance, vibration damping, and close grain.

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B; carbon 2.80, molybdenum .50, chromium .35; also has shock resistance, is vibration damping and has close grain in heavy sections.

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C; carbon 3.00, molybdenum .50, nickel 1.50; properties similar to type A.

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CECOLLOY IRON—Chambersburg Engineering Co., Chambersburg, Pa.; carbon .30, manganese .90, silicon 1.30, nickel 60, molybdenum .50; suitable for casting in cement-bonded sand molds; resists corrosion to atmospheric conditions and acids; has tensile strength 56,000 pounds per square inch; brinell hardness of 255; for steam cylinder liners, cylinders, rings and valves; also beds for heavy duty machine tools.

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CERROBASE—Cerro de Pasco Copper Corp., New York. A Bismuth-lead-casting alloy which expands on cooling; recommended for master patterns, electroforming, engraving machine models, etc.

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CERROBEND—Cerro de Pasco Copper Corp., New York. A Bismuth-lead-tin-cadmium casting alloy which expands on cooling and has the extremely low melting temperature of 160 degrees Fahr., useful as a fusible alloy and as a filler for tube bending.

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CERROMATRIX—Cerro de Pasco Copper Corp., New York. A Bismuth-lead-tin-antimony casting alloy which melts at 240 degrees Fahr. and expands on cooling; used for locating and anchoring machine parts in cored holes.

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CHAMET BRONZE—Chase Brass & Copper Co. Inc., Waterbury, Conn. Copper 60, tin .75, zinc 39.25; for general use where relatively corrosion resistant brass is required.

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Free-cutting; copper 60, tin 0.75, lead 1.5, zinc 37.75; for forming of parts on automatic screw machines where a free-cutting relatively high-strength corrosion resistant brass is required.

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CHASE—Chase Brass & Copper Co. Inc., Waterbury, Conn.

Free-cutting commercial bronze; copper 89, lead 2, zinc 9; for screw machine parts requiring good physical properties and high corrosion resistance.

Also various high and low brasses for a variety of mechanical parts.

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CHROMALOID—American Nickeloid Co., Peru, Ill. Chromium bonded to nickel-bonded zinc, latter serving as rust-proof, flexible and inexpensive white metal base. Available in variety of brilliant finishes and patterns, as sheets, flat strips and coiled strip for continuous feed automatic presses. Can be supplied with quick removable, gum adhered paper covering permitting drawing and forming without marring pre-finish. For reflectors, automotive details, washing machine parts, and for other stamped and formed parts requiring brilliant, permanent finish.

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CHROMAX—Driver-Harris Co., Harrison, N. J.; a heat resisting alloy used for carburizing containers or furnace parts; nickel 35, chromium 19, and balance iron.

- 2 - - - - - 7 - -

CHROMEL—Hoskins Mfg. Co., Detroit.

- 2 - - - - - - - -

No. 502; 18 to 22 chromium, 30 to 34 nickel, balance mainly iron; for burning tools in the enameling industry and for metal furnace parts.

- 2 - - - - - - - -

No. 670; 23 to 28 chromium, 10 to 13 nickel, balance mainly iron; strongly resistant to sulphurous atmospheres.

- 2 - - - - - 7 - -

Grade A; nickel 80, chromium 20; for electric heating elements.

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

1 2 - - - - - - - - -

CIMET—Driver-Harris Co., Harrison, N. J. Nickel 10 to 12, chromium 26-28, and balance iron; castings for furnace parts in high sulphur atmospheres, and for acid resisting castings in the form of pump impellers, piping, etc.

1 2 3 4 5 - - - - -

CIRCLE L—Lebanon Steel Foundry, Lebanon, Pa. This trade name covers forty-three different types of alloys including the following:

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No. 1; manganese 1.40, carbon .35, with vanadium or molybdenum.

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No. 2; carbon .32, chromium .75, molybdenum .30, manganese 1.40; for crankshafts, airplane parts, valves, and other castings.

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No. 3; carbon .50, chromium 1.25, vanadium .12, molybdenum .40, manganese 1.40; for gears and cams.

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No. 6; carbon .5, nickel 1.75, molybdenum .25; for cams, gears and other case hardened parts.

- - 3 4 - - - - - -

No. 8; carbon .20, chromium 2.75, molybdenum .40, vanadium .22; nitriding steel.

1 2 - 4 - - - - - -

No. 10; carbon .20, chromium 5.50, molybdenum .55; for high pressure and high temperature applications in the oil industry.

1 - 3 - - - - - - -

No. 11; carbon .75, chromium 18; hard stainless steel; for sand pumps, etc.

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No. 12; carbon .10, chromium 13; stainless steel; chemical apparatus, etc.

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No. 15; carbon .30, chromium 27; heat and corrosion service.

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No. 22; carbon .07 max., chromium 19.50, nickel 9; for miscellaneous stainless parts and castings to be polished.

1 2 - - - - - - - -

No. 23; carbon .15, chromium 19.50, nickel 9; miscellaneous stainless steel castings.

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No. 24; carbon .15; chromium 9, nickel 19.50; stainless steel.

1 2 - - - - - - - -

No. 25; carbon .15, chromium 21; nickel 10; for valves and pump parts for the paper industry.

1 2 - - - - - - - -

No. 30; carbon .15, chromium 24, nickel 10; uses same as No. 25.

1 2 - - - - - - - -

No. 31; carbon .22, chromium 22, nickel 11; resistant to temperatures up to 2000 degrees Fahr.

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No. 32; carbon .50, chromium 15, nickel 35; heat resisting castings requiring strength at elevated temperatures.

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CLOVERLEAF—E. A. Williams & Son Inc., Jersey City, N. J. Babbitt metal in grades A, B and 0 and 1, 2, 3 and 4, for bushings, bearings, etc.

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COLMONOY—Colmonoy Inc., Los Nietos, Calif.

No. 2; alloy for castings and overlays which resists corrosion due to its chromium-boron content; resists heat up to 1600 degrees Fahr.; has high abrasion resistance, its brinell hardness being 600, and excellent welding qualities; for machine parts where heat and abrasion will be encountered.

No. 3; alloy for castings and overlays which resists corrosion due to chromium-boron-tungsten content; resists heat up to 2000 degrees Fahr.; has high abrasion, its brinell hardness being 650, and excellent welding qualities; recommended for machine parts which must withstand impact.

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No. 6; alloy for castings and overlays which resists corrosion due to its nickel-chromium and boron content; resists heat up to 1600 degrees Fahr.; has high abrasion resistance, its brinell hardness being 550 to 600, and excellent welding qualities; for machine parts where heat and abrasion will be encountered.

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COLUMBIA—Columbia Steel & Shafting Co., Pittsburgh; furnished in rods and bars; tensile strength is high; bearing properties are good; and material machines freely.

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COMMERCIAL—Buckeye Brass & Mfg. Co., Cleveland. Cored and solid bronze bars; copper 80, tin 10, lead 10; for bushings, bearings and bars.

See advertisement page 59D

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COMPO—Bound Brook Oil-less Bearing Co., Bound Brook, N. J. Self-lubricating bushings, bearings and washers.

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COOPER ALLOY—(Formerly Sweetaloy)—Cooper Alloy Foundry Co., Elizabeth, N. J.

No. 16; 18 per cent chromium iron.

No. 17; 18 chromium and 8 per cent nickel.

No. 18; 22 nickel and 10 chromium.

No. 19; 28 per cent chromium.

No. 20; 36 nickel and 18 chromium.

No. 21; 65 nickel and 15 chromium.

No. 22; 28 chromium and 10 nickel; this and above alloys furnished in castings for chemical plant, paper mill, textile and food processing machinery.

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COPPEROID—American Nickeloid Co., Peru, Ill. Copper bonded to zinc, latter serving as rust-proof, flexible and inexpensive white metal base. Available in variety of brilliant finishes and patterns, as sheets, flat strips and coiled strip for use in continuous feed automatic presses. Can be supplied with quick removable gum adhered paper covering permitting drawing and forming operations without marring pre-finish. For machinery trim, nameplates, change gear index plates, etc.

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COP-R-LOY—Wheeling Steel Corp., Wheeling, W. Va. Mild steel containing small percentage of copper. Recommended for boiler tubes, pipes and fabricating requirements where sheets are used.

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COR-TEN—United States Steel Corp. and subsidiaries (See USS). A low alloy-carbon-chromium-copper-silicon-phosphorus steel resistant to atmospheric and salt water corrosion; recommended for lightweight parts where corrosion resistance and high strength are required.

See advertisement pages 6D-7D

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CORVIC BRONZE—Chase Brass & Copper Co., Waterbury, Conn. Copper 98.5 tin 1.5; rod and wire; for use as trolley wire, messenger wire, etc., where high strength and good conductivity are required. Conductivity 40 per cent I. A. C. S.; tensile strength 70,000 lbs. per sq. in.

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CRAMP ALLOYS—Cramp Brass & Iron Foundries Co., Philadelphia.

No. 49; furnished in rough bars or billets, rods or bars and sand castings; resists heat to 400 degrees Fahr.; high abrasion resistance; tensile strength 120,000 lbs. per sq. in.; compressive strength 55,000; medium ductility; specific gravity 6.8; good bearing properties; used for heavy duty, slow moving loads.

No. 99; furnished in rough bars or billets and rods or bars; resists corrosion to sulphuric, sulphurous, acetic acids; heat resistant to 450 degrees Fahr.; high abrasion resistance; tensile strength 55,000 lbs. per sq. in.; compressive strength 22,000; good bearing properties; brinell hardness, untreated, 100; used for high speed bearings and acid resisting parts.

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CROMIN D—Wilbur B. Driver Co., Newark, N. J. Nickel-chromium-iron; high resistivity, for use in low temperature work.

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CROMONITE—Continental Roll & Steel Foundry Co., East Chicago, Ind. Hard alloy chill roll made in four grades, mild, medium, hard and super-hard for special applications.

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CUMLOY—West Steel Casting Co., Cleveland; a molybdenum-vanadium-nickel alloy for steel castings such as cams, gears, levers, and indexing mechanism parts.

1 2 - - 5 - - - - -

CUPALOY—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Copper base alloy containing chromium and silver; thermal and electrical conductivity 80 to 90 per cent of pure copper; tensile properties of steel; brinell hardness up to 140-160; applications include spot-welding tips, seam-welding wheels and rolls, mechanical parts carrying heavy current, etc.

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CUPRON—Wilbur B. Driver Co., Newark, N. J. Nickel copper alloy; supplied in wire and strip form; for rheostats, voltmeters, shunts and other resistances operated below red heat; has moderate resistivity; resists heat up to 1000 degrees Fahr.

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CYCLOPS—Universal-Cyclops Steel Corp., Titusville, Pa.

1 2 3 - - - - - - -

No. 17-A Metal, (Type No. 325); nickel 20, chromium 8; also has high strength and ductility; for turbine blading, high pressure valves and electrical applications—nonmagnetic.

1 - 3 4 - - - - - -

K-Rustless (Type No. 439); chrome 8, tungsten 8, carbon 0.60; is heat resisting; has bearing and cutlery application.

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CYCLOPS ORION—Universal-Cyclops Steel Corp., Titusville, Pa. Chrome vanadium steel for machine parts.

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CYCLOPS WANDO — Universal-Cyclops Steel Corp., Titusville, Pa. Carbon 0.95, manganese 1.05, chromium 0.50, tungsten 0.50, vanadium 0.20; oil hardening, nonshrinking tool and die steel.

D

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DAVIS METAL—Chapman Valve Mfg. Co., Indian Orchard, Mass. Corrosion re-

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

sisting iron; carbon and silicon 0.5, manganese 1.5, nickel 29, iron 2, copper 67 per cent; for valves and fittings.

1 2 - 4 - - - - - -

DEFIHEAT—Rustless Iron & Steel Corp., Baltimore. Carbon .35 max., chromium 23 to 30; resists nitric and sulphuric acids, also heat up to 2000 degrees Fahr.; for furnace parts and other applications involving high heat.

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DEFIRUST—Rustless Iron & Steel Corp., Baltimore.

1 2 - 4 - - - - - -

No. 410 stainless type; carbon .12 max., chromium 10 to 13.5; hardening type of stainless steel for turbine blades.

No. 416 machining type; carbon .12 max., sulphur .5 and chromium 12 to 14; hardening type of stainless steel possessing free cutting properties.

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DEFISTAIN—Rustless Iron & Steel Corp., Baltimore.

1 2 - 4 - - - - - -

Types 302, 304 and 308; carbon .082 to .12 max. and .08 max., manganese .25 to .6, chromium 17 to 20 nickel 7 to 10; retains high tensile strength and resistance to creep up to 1300 degrees Fahr.; nonmagnetic resists nitric acid, salt air, and food; resists heat up to 1600 degrees Fahr.; recommended for machinery parts which come in contact with food.

Type 303, machining; carbon .15, sulphur .15, chromium 17 to 19 and nickel 7 to 9.5; also has high ductility and free cutting properties; resists heat up to 1550 degrees Fahr. and has tensile strength up to 200,000 pounds per square inch; recommended for same purposes as above where free cutting is desirable.

1 2 3 - - - - - -

3 MO, types 316-317; carbon .10 max., chromium 14 to 18, nickel 14 max., molybdenum 2 to 4; corrosion resistant; used for parts in paper and pulp, and chemical industries.

1 2 - 4 - - - - - -

Columbium, type 347; carbon .10 max., chromium 17 to 20, nickel 8 to 12; columbium ten times carbon; same properties as Defistain except welded equipment does not require annealing after welding; material is stabilized.

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DEWARD—Allegheny-Ludlum Steel Corp., Pittsburgh. Carbon 0.9, manganese 1.50, molybdenum 0.30; for holders for thread chasers and gang punches. Oil hardening.

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D-H-S BRONZE—Koppers Co., Bartlett-Hayward Div., Baltimore. Furnished in rough bars of billets, rods and bars; also as sand castings; zinc 21 to 25, copper 61 to 66, hardener (aluminum, manganese and iron) 13 to 15; resists corrosion, heat resistant up to 400 degrees Fahr.; high abrasion resistance; tensile strength 95,000 to 125,000 lbs. per sq. in.; compressive strength 90,000; specific gravity .28 lbs. per cu. in.; nonmagnetic; brinell hardness, untreated, 190 to 255; used for heavily loaded machine parts such as screw-down nuts, worm gear rims, pressure blocks, reel segments, etc.

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DIAMITE—Weatherly Foundry & Mfg. Co., Weatherly, Pa. Nickel 4-6, chromium 2-3 per cent, an abrasion-resisting, sand-casting material suitable for parts of pulverizing machinery.

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DIAMOND G BRONZE—E. A. Williams & Son Inc., Jersey City, N. J. for bearings, bushings and mill brasses, either finished or in the rough.

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DIXOILBRONZ—Thos. F. Seitzinger's Sons, Atlanta, Ga. Bearing bronze as sand castings; resists corrosion due to high lead content; heat resistant up to 500 degrees; tensile strength varies according to grade, as does brinell hardness; recommended for bearings, bushings, gears, pump runners, pump liners, and is used extensively in oil field equipment.

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DM STEEL—Timken Steel & Tube Div., The Timken Roller Bearing Co., Canton, O. Carbon under 0.15, manganese 0.30 to 0.60, silicon 0.75 to 1.25, chrome 1 to 1.50, molybdenum 0.40 to 0.60, phosphorus 0.04 max., sulphur 0.04 max., good resistance to creep to 1200 degrees Fahr.; for power and refinery equipment such as tubing.

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DOLER-ALUMIN—Doehler Die Casting Co., New York. Aluminum base die castings. Composition suited to meet stringent requirements, for high tensile strength, impact strength, hardness, corrosion resistance, thermal conductivity and electrical conductivity.

1 2 - 4 - - - - - -

DOLER-BRASS—Doehler Die Casting Co., New York. Brass die castings. Composition suited to meet varying conditions. Tensile strength up to 100,000 lbs. per sq. in., and hardness up to 180 brinell; excellent corrosion resisting properties.

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DOLER-MAG—Doehler Die Casting Co., New York. Magnesium base die castings made from the lightest of the commercial metals. One third lighter than aluminum.

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DOLER-ZINK—Doehler Die Casting Co., New York. Zinc base die castings of maximum tensile and impact strength.

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DOWMETAL—The Dow Chemical Co., Midland, Mich.

Alloy E; aluminum 6, manganese .20, and magnesium remainder; plate, sheet and strip with maximum properties; available in hard rolled and annealed tempers.

Alloy H; aluminum 6, manganese .20, zinc 3, and magnesium remainder; sand castings and press forgings for aircraft and general usage; improved salt water resistance; may be heat treated to secure high tensile strength and toughness, or heat treated and aged to secure high yield strength with moderate toughness.

Alloy L; aluminum 2.5, cadmium 3.5 manganese .30, and magnesium remainder; best hammer forging alloy, hammer forgings for aircraft and other industries.

Alloy M; manganese 1.5, magnesium remainder; plate, sheet, strip, extruded shapes, die castings and forgings of moderate strength for all uses demanding maximum salt water resistance.

Alloy O; aluminum 8.5, manganese .2, zinc .5, and magnesium remainder; simple press forgings and extruded sections of high yield strength.

Alloy R; aluminum 9, manganese .15, zinc .6, and magnesium remainder; most generally used die casting alloy combining maximum toughness and elongation with good tensile and yield strengths.

Alloy X; aluminum 3, manganese .2, zinc 3 and magnesium remainder; press forgings, extruded bars, rods, and shapes with best combination of salt water resistance and properties; aging after forging or forming increases yield strength.

See advertisement page 5D

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DRAGON—Allegheny-Ludlum Steel Corp., Pittsburgh. Carbon .33, manganese .55, chrome .65, molybdenum .35; high degree of toughness with moderate hardness; water hardening; for use as bucket teeth, keys, pins, bolts, studs, etc.

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DRIVER-HARRIS 42 ALLOY — Driver-Harris Co., Harrison, N. J.; notable for its coefficient of linear expansion—approximately that of different grades of glass.

1 2 - - - - - 7 - -

DRIVER-HARRIS 52 ALLOY — Driver-Harris Co., Harrison, N. J.; alloy of nickel and iron which has been successfully used for sealing in glass and in which process no coating is required prior to the operation.

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DUPLEX—Crucible Steel Co. of America, New York.

No. 1, nickel 3.50, chromium 1.50; forging steel; for shafts and machine parts requiring high strength and toughness; also made in case carburizing type.

No. 2; nickel 1.75, chromium 1; also a forging steel for applications similar to those of No. 1, and made in case carburizing type.

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DUQUESNE SPECIAL—Continental Roll & Steel Foundry Co., East Chicago, Ind. Chrome molybdenum steel for rolls subject to severe service; also for abrasive castings.

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DURACAST—West Steel Casting Co., Cleveland; for steel castings of 90,000 pounds per square inch tensile strength and brinell hardness of 180; for cams, gears, etc.

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DURALOY—Duraloy Co., New York.

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H; 27 to 30 chromium, high carbon.

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B; 16 to 18 chromium.

C; 12 to 14 chromium.

N; 21 to 24 chromium, 12 nickel.

18-8; 18 chromium, 8 nickel.

15-35; 15 chromium, 35 nickel; for castings.

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DURCO — Duriron Co. Inc., Dayton, O. Alloy steels (KA2S, KA2SMo., etc.); 18 chrome, 8 nickel, carbon max. .07 per cent, and other standard as well as special analyses preferred by users; for pumps, valves, fittings, castings for corrosive service, etc.

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DURICHLOR—Duriron Co. Inc., Dayton, O. Silicon 14, molybdenum 4, carbon .80, traces of phosphorus and sulphur, balance iron; for pumps, valves, pipe, castings for corrosive service, especially for hydrochloric acid and chloride solutions.

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DURIMET—Duriron Co. Inc., Dayton, O. Nickel 23, chromium 20, silicon, molybdenum and copper 5 approx., carbon .07 max., balance iron; for pumps, valves, bolts, nuts and castings for corrosive service, especially weak sulphuric acid.

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DURIRON—Duriron Co. Inc., Dayton, O., and licensees including Shawinigan Chemicals Ltd., Montreal, Que. Silicon 14.50, carbon .80, manganese .60, sulphur and phosphorus traces, balance iron; for pumps, valves, exhaust fans, mixing nozzles, and castings for handling acids and other corrosive liquids and gases.

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DURONZE ALLOYS—Bridgeport Brass Co., Bridgeport, Conn. High copper silicon

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

bronzes alloyed with elements such as tin, iron, aluminum, etc.; possess high strength combined with fine corrosion resistance.

I; possesses excellent cold working properties; cold headed bolts and screws, average 100,000 pounds per square inch in tensile strength; available in rod, wire and sheet form.

II; hot rolled sheet for making range boilers, automatic heaters and storage tanks by either electric arc or oxyacetylene welding methods; cold rolled strip used as a substitute for phosphor bronze spring metal; rod and wire used for making hot headed bolts and screw products; supplied in sheet, rod, wire, tube and ingot forms.

III; supplied in rod form; tensile strength about 100,000 pounds per square inch. Hot forgings have a tensile strength of about 90,000 pounds per square inch; free machining for making screw machine parts, also for sucker rods for corrosive oil wells. 10 per cent lighter than brass; excellent corrosion resistance Duronze III ingot for making sand castings with tensile strength about 70,000 lbs. per sq. in.

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IV; made into condenser tubes only; fine for resisting corrosion from aerated sea water.

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DUTCH BOY BABBITT—National Lead Co., New York. Analysis varies for different bearing applications.

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DYNAMIC STEEL—Continental Roll & Steel Foundry Co., East Chicago, Ind.

C-2; low carbon, manganese, nickel cast steel for parts requiring high physical properties; for tractor frames, locomotive castings, etc.

C-3; medium carbon, manganese, nickel cast steel for resisting wear after a preferential heat treatment; for sprockets, spindles, wheel centers, cross heads, etc.

C-3-A; medium carbon, manganese molybdenum cast steel for parts requiring high physical properties, with machinability; for gears, racks, sprockets and miscellaneous castings.

C-6; high chromium cast steel for special abrasive and crushing work; for sand mills, rock crushers, etc.

C-7; medium carbon, chromium nickel, molybdenum cast steel for castings requiring high physical and severe service qualities.

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EASY-FLO—Handy & Harman, New York. Brazing alloy; silver 50, copper 15.5, zinc 15.5 and cadmium 18; resists corrosion due to silver content, specific gravity 9.49; for brazing ferrous and nonferrous metals, particularly dissimilar metals and monel metal, stainless steel and other copper-nickel and chrome-nickel alloys.

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ECONOMET—General Alloys Co., Boston; nickel 30, chromium 10; resists heat up to 1800 degrees Fahr.; has tensile strength of 70,000 lbs. per sq. in.; for castings subject to high temperatures.

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ECONOMO—Wheelock Lovejoy & Co. Inc., Cambridge, Mass. Carbon 0.20 and 0.50 with alloy of molybdenum; free machining; for machine tool parts.

ELECTROMET — Electro Metallurgical Sales Co., New York. A line of ferro-alloys and alloying elements of various analyses.

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ELINVAR—Produced by Acieries d'Imphy, France; marketed in United States and Canada by R. Y. Ferner Co., Boston. Alloy with low thermal coefficient of elasticity; nickel 33 to 35, iron 53 to 61, chromium 4 to 5, tungsten 1 to 3, manganese 0.5 to 2, silicon 0.5 to 2, carbon 0.5 to 2; for watch and instrument hairsprings and tuning forks.

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ELKALOY—P. R. Mallory & Co. Inc., Indianapolis. A primary alloy of copper for spot and seam welding aluminum and its alloys, unpickled hot rolled steel, terne plate, tin plate, galvanized iron and other materials. A direct substitute for copper, it handles like copper but is harder and lasts longer.

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ELKONITE—P. R. Mallory & Co. Inc., Indianapolis. Two definite classes of materials. One group based on copper and such refractory metals as tungsten, molybdenum and their carbides—combinations which produce material with good electrical conductivity and great wear-resistant qualities, for use as welding electrodes and contactors in oil-immersed circuit breakers. Another group is based on silver and refractory materials such as tungsten, molybdenum and their carbides, and has been developed primarily as a facing material for heavy duty electrical contacts and contactors for air breakers. This material can be used either in the form of a thin facing or as an insert with copper or copper alloy backing material.

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ELVERITE—Babcock & Wilcox Co., New York. Special chilled iron castings; for tube mill lining, car wheels, jaw crushers, sprockets, etc.

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EMPIRE — Empire Steel Castings Inc., Reading, Pa. Alloy steel castings to all standard chrome-nickel specifications; also possess high strength and ductility, and are suitable for heat treating.

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ENDURIA—Bethlehem Steel Co., Bethlehem, Pa. Special carbon spring steel.

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ENDURO—Alloy Steel Div., Republic Steel Corp., Massillon, O. Stainless and heat resisting alloy.

Chromium-nickel group:

18-8; chromium 18, nickel 8, carbon .08 to .20; especially suited to resist atmospheric corrosion, and corrosion reagents; for dairy and chemical plant equipment, food and meat processing machinery, high strength light weight structural members, and for resistance to oxidation at elevated temperatures.

18-8 S; similar to 18-8 except carbon is kept under .08 which permits its use in welded equipment subject to severe corrosion.

18-8-FS; a special modification of 18-8 to develop greater softness and less work hardening; better adapted to successive drawing and spinning operations with less annealing than 18-8.

18-8 S Ti; 18-8 S to which titanium has been added for eliminating intergranular corrosion at high temperatures; used for airplane collector rings and exhaust manifolds, and other high temperature requirements.

18-8 S Cb; 18-8 S plus columbium; for applications similar to those for which 18-8 S Ti is recommended. More efficient as carbide stabilizer and better corrosion resistance than titanium.

18-8 S Mo; 18-8 S plus 2 to 4 molybdenum; resistant to acids encountered in paper and pulp processes, woolen dyeing and in chemical and pharmaceutical industries; recommended for severe corrosive conditions; good fabricating and welding properties.

18-8-B; 18-8 with 2 to 3 silicon; for resistance to oxidation up to 1650 to 1700 degrees Fahr.; for annealing boxes, furnace parts, etc.

18-8-FM; a free-machining type of 18-8 through addition of .15-.30 selenium; machinability very good for chromium-nickel type—about 60 per cent that of screw stock. Corrosion resistance same or very little less than 18-8.

HCN; chromium 25, nickel 12; for resistance to oxidation up to 1950 degrees Fahr.; fabricates, machines, and welds readily. High strength and creep at elevated temperatures. Not recommended for high sulphur conditions at high temperatures.

NC-3; chromium 25, nickel 20 and silicon 2 max.; for maximum heat resistance. Best strength and creep at high temperatures, but may be attacked if sulphur present in gases. Resistant to carburizing.

Straight chromium group:

S-1; chromium 11.5 to 13, carbon .12 max., responds readily to heat treatment and is recommended where strength, toughness and hardness are required; for pump shafts, valve seats and stems, nuts and bolts, etc.

FC; free machining grade of S-1 analysis. Machines nearly as well as screw stock. Fairly resistant to the atmosphere, organic and fruit acids, etc. Can be hardened by heat treatment up to about 400 brinell. Considerably more care and control required in forging operations than with S-1.

AA; chromium 14 to 18, carbon under .12; good corrosion resistance and heat resistant to 1500 degrees Fahr.; general corrosion resistance; fabricating and welding properties inferior to 18-8; for bicycle fenders, oil burner parts, etc.

HC; chromium 18 to 30; heat resistant to 2000 degrees Fahr. Very good heat resistance and not affected by sulphur gases; strength and creep at high temperatures not as good as the chromium-nickels.

18-23; chromium 18 to 23; high heat resisting properties; good resistance to scaling, but strength and creep lower than chromium-nickel types; for furnace parts, etc.

4-6 per cent; chromium 4 to 6 with several carbon ranges up to .25 and with or without addition of molybdenum or columbium, titanium, aluminum and tungsten; additions of columbium, titanium or aluminum practically eliminate air hardening on welding; corrosion and heat resistance considerably superior to that of carbon steels, and with fair strength at high temperatures; for oil refinery and furnace parts.

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ERMAL—(Z-Metal)—Erie Malleable Iron Co., Erie, Pa. A spheroidized pearlite malleable cast iron; for castings requiring rigidity and high tensile strength.

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ERMALITE—Erie Malleable Iron Co., Erie, Pa. Wear resisting alloy iron; for gears, wearing plates, friction drums and other parts subject to high stresses or wear.

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EVANSTEEL — —Chicago Steel Foundry Co., Chicago. Nickel 1 to 1½ per cent, chrome .65 to 1, carbon varies from .30 to .50, sometimes carries additions of vanadium or molybdenum; for castings such as passenger car knuckles, tooth bases, sprockets, gears, high pressure valves, etc.

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EVERDUR—American Brass Co., Waterbury, Conn.

Alloy No. 1010; copper 96, silicon 3, manganese 1; uses include tanks and sewage disposal apparatus.

Alloy No. 1015; copper 98.25, silicon 1.50, manganese .25; easily fabricated by all methods including welding; used for tubes, bolts and screws.

Alloy No. 1000; casting alloy; copper 90.94, manganese 1.01, silicon 4.

See advertisement pages 9D-12D

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

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FAHRITE—Ohio Steel Foundry Co., Springfield, O.

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N-1; carbon .45 to .55, chromium 15 to 18, nickel 34 to 38; furnished in rods or bars and castings, for sand casting and welding into parts; resists corrosion due to acid-furnace cases; heat resistant up to 2000 degrees Fahr.; medium abrasion resistance; tensile strength, ultimate, 70,000 pounds per square inch; specific gravity 7.94; good weldability; brinell hardness, untreated, 160 to 170; and used for carburizing pots, trays, retorts and enameling and furnace parts.

1 2 - 4 - - - - -

N-3; carbon .35 to .50, nickel 10 to 13, chromium 24 to 27; furnished in rods or bars for sand casting, and welding into parts; resists heat up to 1900 degrees Fahr.; medium abrasion resistance; tensile strength ultimate, 100,000 pounds per square inch; medium ductility; specific gravity, 7.73; fair bearing properties; weldability, good; brinell hardness, untreated, 165 to 175; and used for pots, trays and furnace parts.

1 2 - - - - - - -

N-5; carbon .50 to .60, nickel 59 to 62, and chromium 10 to 14; furnished for sand casting and welding into parts; resists corrosion due to carburizing atmosphere; heat resistant up to 2000 degrees Fahr.; medium abrasion resistance; tensile strength, ultimate, 70,000 pounds per square inch; medium ductility; specific gravity, 8.13; fair bearing properties; good weldability; brinell hardness, untreated, 170 to 180; used for furnace parts.

N-7; carbon .35 max., nickel 3 max. and chromium 25 to 30; furnished for sand casting and welding into parts; resists corrosion due to sulphur gas atmosphere; heat resistant up to 1900 degrees Fahr.; tensile strength ultimate, 90,000 pounds per square inch ductility, 18; specific gravity, 7.6; good bearing properties; fair weldability; brinell hardness, untreated, 150; heat treated, 200; used for parts subjected to high temperature in sulphur atmosphere.

N-9; carbon .15 max., nickel 1 max., chromium 12 to 14; for sand casting and welding into parts; resists corrosion caused by atmosphere salt water, etc.; heat resistant up to 1200 degrees Fahr.; medium abrasion resistance; tensile strength 120,000 lbs. per sq. in.; ductility 17 per cent; specific gravity 7.7; good bearing properties; good weldability; brinell hardness, untreated, 160, heat treated 269; used for valve and pump parts in salt water, gasoline, oils, etc.

1 2 3 - - - - - -

N-17; carbon .20, chromium 16 to 20, and nickel 2; furnished for sand casting and welding into parts; resists corrosion due to nitric acid; heat resistant up to 1500 degrees Fahr.; tensile strength, ultimate, 80,000 pounds per square inch; ductility, 30; specific gravity, 7.7; good bearing properties; brinell hardness, untreated, 165 to 175; for valve and pump parts.

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C-8; carbon .12 max., nickel 7 to 9, chromium 17 to 21; furnished in rods bars and tubing, also as sand casting, for welding into parts; corrosion resistant; medium abrasion resistance; tensile strength 75,000 lbs. per. sq. in.; high ductility, specific gravity 7.8; fair bearing properties; good weldability; brinell hardness, untreated, 140; for valves, fittings, etc. subjected to corrosive liquids.

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FARRELL'S 85—Farrell-Cheek Steel Co., Sandusky, O. Specially processed steel castings for resisting abrasion, and possessing high strength, toughness and rigidity; tensile strength is 150,000 lbs. per sq. in.

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FEDERAL-MOGUL BRONZES—Federal-Mogul Corp., Detroit.

F1; a gear bronze suitable for heavily loaded piston pin bushings, etc.

F2; lead bronze for average bushing application.

F3; used largely as backs for babbitt-lined bearings.

F5; widely used for babbitt-lined bearing backs and for bushings where service is not severe.

F6; for average bushing applications.

F8; good casting and machining qualities.

F11; for piston pin bushings and other low speed, heavily loaded applications.

F13; suitable for many of the uses to which F1 is applied.

F15; has 20 per cent lead and may be used safely under adverse lubrication conditions.

F16; because of high lead content may be used where only occasional lubrication is possible.

F18; high lead alloy of good casting characteristics.

F19; strong ductile alloy of average hardness with bearing qualities corresponding to other low lead compositions.

F20; a very hard bronze used for gears and worm wheels where requirements are severe; also aluminum bronze and special analysis bronzes.

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FERRODUR—Janney Cylinder Co., Holmesburg, Philadelphia. Special alloy iron furnished as centrifugal castings; resists heat to 450 degrees Fahr.; high abrasion resistance; tensile strength, 50,000 lbs. per sq. in.; compressive strength 50,000; specific gravity .26 lbs per cu. in.; good bearing properties; medium magnetic and electrical properties; brinell hardness, heat treated, 500 to 550; used for pump liners, sleeves for plungers and centrifugal pump shaft sleeves

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FIRE ARMOR—Michiana Products Corp., Michigan City, Ind. Nickel 65, chromium 20 per cent.

Type B; nickel 60, chromium 12 per cent.

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FIRTHITE—Firth-Sterling Steel Co., McKeesport, Pa. Hard metal composition of sintered carbides furnished in number of grades to form wearing surfaces or the edges of cutting tools.

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FLINTCAST—Pacific Foundry Co., San Francisco, Calif. An abrasion resisting iron.

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GLYCO BABBITT—Joseph T. Ryerson & Son, Inc., Chicago. General tradename covering a group of specially processed lead base alloys including:

Turbo-Glyco; for high speed, heavy-duty; average brinell hardness, 30.

Marine Glyco; for electric motor and marine work; average brinnell hardness 27.

Standard Glyco; free flowing, general purpose; average brinell hardness 24.

Transmission Glyco; for line shafting and transmission work; average brinell hardness, 22.

Heavy pressure mill Glyco; high resistance to crushing loads; average brinell hardness 25.

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GOHI—Newport Rolling Mill Co., Newport, Ky. Iron-copper alloy; carbon .02, manganese .025; sulphur .025, phosphorus .005, silicon .003, copper .25; for any sheet or plate application such as in ventilating systems, fabricated sheet metal parts, etc.

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GRAMIX—The United States Graphite Co., Saginaw, Mich. Bearing bronze; resists heat up to 300 deg. Fahr.; tensile strength 12,000 lbs. per sq. in.; compressive strength 100,000; specific gravity 5.9 to 6.1 (apparent density); brinell hardness, untreated, 500 kilograms—28; used for bearings, contacts, slides and thrust bearings.

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GRAPHALLOY — Graphite Metallizing Corp., Yonkers, N. Y.; metal-graphite; copper Graphalloy used for brushes, contacts, etc., on electrical machinery; babbitt Graphalloy and copper Graphalloy used for self-lubricating bushings furnished in rods or in finished bushings.

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GRAPHO—Lehigh Babbitt Co., Allentown, Pa.; a homogeneous mixture of graphite and babbitt which can be poured in the usual way; recommended for bearings subject to lubricating difficulties.

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GUNITE—Gunite Foundries Corp., Rockford, Ill. Low carbon high test cast iron; for brake drums, cylinders, dies, hydraulic castings, etc.

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HALCOMB—Halcomb Steel Co., Syracuse, N. Y.

Stainless Steels, Grade A; chrome 12.5 Grade B; chrome 17.

Stainless Irons, FM2; chrome 12; for free machining corrosion resistant parts.

No. 12; chrome 12 to 13.

No. 16; chrome 15 to 16.

No. 18; chrome 18 to 20.

No. 24; chrome 24 to 26.

NCR-238 and Rezistal; stainless steels in various grades for corrosion and heat resistant parts.

HANDY FLUX—Handy & Harman, New York. For brazing steel, stainless steel, monel metal, nickel, copper, beryllium-copper, brass, bronze, aluminum bronze and various other ferrous and nonferrous metals and alloys.

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HARDTEM—Heppenstall Co., Pittsburgh. Carbon .5, nickel chrome molybdenum die steel; for die blocks, shafting, etc.

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HARDWELD—Lincoln Electric Co., Cleveland. High carbon arc welding electrode having brinell of 225-488; provides dense, tough surface of moderate hardness to enable various steel parts to resist shock and abrasion; for locomotive or crane tire flanges, etc.

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HASCROME—Haynes Stellite Co., Kokomo, Ind. Alloy of chromium, manganese and iron; castings, sheet and hard facing welding rod or parts subject to abrasion and impact.

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HASTELLOY—Haynes Stellite Co., Kokomo, Ind. For piping, tanks, pump parts, valves, vessels, etc.

A and B; nickel, molybdenum and iron.

C; nickel, molybdenum, chromium and iron.

D; nickel, silicon, copper and aluminum.

1 2 3 - - 6 - - -

HAYNES STELLITE—Haynes Stellite Co., Kokomo, Ind. Nonferrous cobalt-chromium-tungsten alloy for corrosion and wear-resistant castings, hard-facing welding-rod for parts subjected to abrasion or a combination of abrasion, heat and corrosion.

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

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HAYSTELLITE—Haynes Stellite Co., Kokomo, Ind. Cast tungsten carbide; for inserts and composite rod (welding rod) for oil-well drilling tools, dredge cutter blades, etc.

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HEPPENSTALL 2C30—Heppenstall Co., Pittsburgh. Nickel-chrome-molybdenum steel, .3 carbon; for shafting where high torsional strength is required such as drop hammer piston rods.

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HERCULOY—Revere Copper & Brass Inc. New York. Silicon bronze; silicon 3.25 tin .50; balance copper; in addition to properties indicated, it is nonmagnetic; made in sheets, strip, plates, cold drawn rods, shafting, welding rod, forgings, ingot form for sand castings; for piston rods, shafting, electrical construction, etc.

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HIGH TEST—International Nickel Co. Inc., New York and licensees. Nickel 1 to 1.25, total carbon 2.75 to 3.15, manganese .60 to 1, silicon .9 to 1.10; nickel cast iron possessing high tensile strength; for brake drums, diesel engine liners and heads, paper and printing press rolls, and valve bodies.

See advertisement page 51D

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HIOLOY—Ohio Steel Foundry Co., Springfield, O.

Type 0-3; carbon .35 max., nickel 1 to 1.75, chrome .40 to .80, molybdenum .20 to .30; parts for refinery equipment where strength is major consideration.

Type 0.4; carbon .32 max., chrome 4 to 6, molybdenum .50 to .65 for refinery fittings to resist corrosion.

Type 0-6; carbon .75 max., chrome .80 to 1.20, vanadium .15 to .22; for cement mill liners and screen plates, conveyor pipe for abrasive materials, sand mill parts, etc.; available in cast form.

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HIPERNIK—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. A magntic alloy consisting of 50 per cent nickel and 49 iron; extremely ductile; developed for special magnetic properties at moderately low induction, primarily for radio applications; melting point is 1450 degrees Cent.; sometimes used for heater elements for high temperature furnaces with reducing atmospheres.

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HOYT BABBITT METAL — National Lead Co., New York. Analysis according to bearing application.

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HUBBARD SPECIAL—Continental Roll & Steel Foundry Co., East Chicago, Ind. Nickel chrome steel for wear resisting rolls, guides and miscellaneous castings.

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HYB-LUM—Sheet Aluminum Corp., Jackson, Mich. Corrosion resisting, general purpose alloy containing nickel, copper, manganese, silicon and pure aluminum.

Grade A; high strength; heat treating or non-heat treating.

Grade B; medium strength; heat treating or non-heat treating.

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HYBNICKEL — Victor Hybinette, Wilmington, Del.

Types A, B, C, D, R and S; a series of nickel-chrome alloys for heat and acid resistance.

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HYLASTIC—American Steel Foundries, Chicago. Carbon .35, manganese 1.50, vanadium .10 to .12, phosphorus and sulphur not over .05; also furnished with the addition of chromium where greater resistance to abrasion is desirable; for rolling mill machinery, automotive and railroad equipment, hammer mills and hydraulic machinery.

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HY-SPEED—Buckeye Brass & Mfg. Co., Cleveland. Copper 88, tin 10 and lead 2 per cent; for bushings, bearings, bars.

See advertisement page 79D

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HYTEMCO—Driver-Harris Co., Harrison, N. J., alloy of nickel and iron characterized chiefly by its high temperature coefficient of electrical resistance; lends itself advantageously to uses requiring self regulation by temperature such as immersion heaters and heater pads.

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HY-TEN—Wheelock-Lovejoy & Co. Inc., Cambridge, Mass. Chrome-manganese-molybdenum and chrome-nickel-molybdenum alloys with carbon from .10 to 1.

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IDEALOY—Wellman Bronze & Aluminum Co., Cleveland. Copper-tin-zinc alloy for heavy duty bearings.

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ILLIUM—Burgess-Parr Co., Freeport, Ill.

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G; nickel 58, chromium 22, copper 7, aluminum 4 to 6, balance iron, tungsten and manganese; brinell hardness 170 to 220; for pumps, meters, chemical equipment and other parts subject to corrosion; resists heat up to 2200 degrees Fahr.; resists most corrosion solutions except chlorides and other halogens.

1 . 3 4 5 . . . .

R; nickel 58, chromium 21 to 23, copper 0 to 4, molybdenum 4 to 6, balance iron, tungsten and manganese; brinell hardness 215 to 240 untreated, and up to 365 heat treated; resists most corrosive solutions except those containing chlorides and other halogens; resists heat up to 2000 degrees Fahr.; tensile strength 90 to 105,000 lbs. per sq. in. annealed and 40,000 to 150,000 upon work hardening.

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INCONEL—International Nickel Co. Inc., New York. Composition is nickel 79.5, iron 6.5, copper .2, manganese .25, silicon, .25, carbon .08 and chromium 13; resists heat up to 2000 degrees Fahr.; uses include high temperature applications, springs, and machinery handling food products.

See advertisement page 51D

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INDUSTRIAL—Industrial Steels Inc., East Cambridge, Mass.

Stainless Steel, No. 35; chrome 13 to 14, carbon .30 to .40. No. 65; chrome 16 to 17, carbon .60 to .70. No. 100; chrome 17 to 18, carbon .9 to 1.

Stainless Iron, No. 12, chromium 11½ to 13. No. 18; chromium 16 to 20. No. 512; chromium 11½ to 13, .12 carbon, 0.3 to 0.4 sulphur, balance iron. No. 188; chromium 17 to 20, nickel 8 to 10. No. 5188; chromium 17 to 20, nickel 8 to 10. No. 188 SMO; chromium 17 to 20, nickel 8 to 10, molybdenum 2 to 4 per cent.

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INGACLAD—Ingersoll Steel & Disc Co., div. of Borg-Warner Corp., Chicago.

Stainless clad steel consisting of a 20 per cent layer of 18-8 chrome nickel, Type 306, also 18.8 columbium stabilized and 18-8 molybdenum bearing, stainless layer bonded to a layer of ordinary steel; uses include equipment for chemical, food, dairy, processing, brewery, packing house, bottling industries, etc.; suitable for applications requiring stainless steel protection on one surface.

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INLAND—Inland Steel Co., Chicago.

Copper bearing steel; used largely for sheets; copper minimum .20.

Silico-manganese spring steel.

Hi-Steel; high strength, low-alloy steel for applications where increased strength and corrosion resistance with decreased weight is desired. A copper-nickel-phosphorus alloy steel.

1 2 . 4 . . . . .

INVAR—Produced by Acieries d'Imphy, France; marketed in United States and Canada by R. Y. Ferner Co., Boston. An alloy with a low coefficient of thermal expansion; nickel 36, iron 61 to 64, carbon 0 to 1, manganese .1 to 1, silicon .1 to 1; for clock pendulums, instruments, struts for auto pistons.

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IRALITE—Mackintosh-Hemphill Co., Pittsburgh. Alloy iron; specified where sand cast iron could be used except for lack of strength.

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ISOROD—Resisto-Loy Co., Grand Rapids, Mich.; carbon 3, silicon 1, manganese 2, chromium 2, molybdenum 5, and nickel 2; fair resistance to acids and alkalies; resists heat up to 800 degrees Fahr.; tensile strength 78,000 lbs. per sq. in.; brinell hardness 545; for use where wear and shock resistant properties are desired.

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JALCASE—Jones & Laughlin Steel Corp., Pittsburgh.

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Low carbon open hearth steel which offers machinability practically equivalent to Bessemer screw stock plus the added advantage of rapid case carburizing properties; manufactured as S.A.E. X1314 and S.A.E. X1315 in .10 to .20 carbon grades.

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Open hearth steel which in the higher carbon ranges, offers exceptional heat treating qualities combined with forging properties and good machinability; manufactured as S.A.E. X1330 (.25/.35 carbon), S.A.E. X1335 (.30/.40 carbon) and S.A.E. X1340 (.35/.45 carbon).

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JAL-TEN—Jones & Laughlin Steel Corp., Pittsburgh. High tensile steel; especially suitable for machine frame or bin construction; adaptable to hot or cold forming and is easily welded or punched for rivets or bolts; made in standard sections and shapes as specified.

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JANNEY—Janney Cylinder Co., Holmesburg, Philadelphia. Following all furnished as centrifugal castings.

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Pressure-tite iron; nickel 1.25, chromium .40; not corrosion resisting; heat resistant to 1000 degrees Fahr.; high abrasion resistance; tensile strength 55,000 lbs. per sq. in.; compressive strength 45,000; specific gravity .26 lbs. per cu. in.; very good bearing properties; fair magnetic and electrical properties; brinell hardness, untreated, 240-285; used for diesel engine liners, compressor liners, pump liners and bearings.

. . . 4 . . . . .

High tensile bronze; complex manganese aluminum bronze; resists corro-

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

sion due to neutral solutions; resist heat up to 500 degrees Fahr.; tensile strength 90,000 to 120,000 lbs. per sq. in.; compressive strength 45,000 to 60,000; medium ductility; fair bearing properties; brinell hardness, untreated, 175 to 220; used for pump liners, hydraulic press liners, sleeves, bushings, nuts, glands and rings.

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Alloy No. 20; copper 79, nickel 2, tin 5, and lead 14; resists corrosion due to most acids except nitric, alkalies except ammonia; high abrasion resistance; tensile strength 28,000 lbs. per sq. in.; compressive strength 20,000; medium ductility; specific gravity .34 lbs. per cu. in.; very good bearing properties; brinell hardness, untreated 75 to 85; used for bearing bushings, sleeves and pump liners.

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JELLIFF—C. O. Jelliff Mfg. Corp., Southport, Conn.

Alloy A; nickel 80, chromium 20, essentially iron free; non-magnetic; suitable for temperatures up to 2100 degrees Fahr.

Alloy C; nickel 64, chromium 15, iron 20; uses include electric heating elements for domestic appliances and rapid resistors.

Alloy D; nickel 20, chromium 15, iron 55; electrical resistance; low temperature heating elements.

Alloy 45; nickel 45, copper 55; temperature coefficient of resistivity is practically nil for use in electric measuring testing instruments.

Alloy 70; nickel and copper alloy intended principally for use in electrical heating devices up to 1100 degrees Fahr.

- 2 3 4 - - - - - -

JEWELL-ALLOY — Jewell Alloy & Malleable Co., Buffalo. Nickel 1.25, total carbon 1.75 to 1.80, silicon .90, chromium .50; castings for machine parts including cams, compressor valve seats and valve inserts.

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JOHNSON—Johnson Bronze Co., New Castle, Pa.

No. 27; copper 80, tin 10, lead 10; deoxidized with phosphorus; general purpose bearing bronze.

No. 19; copper 70, tin 11, lead 19; high wear rating and resistance to pounding; for mill bearings, gas and diesel engines, excavating and pulverizing machinery, etc.

No. 25 (plastic bronze); copper 75, tin 5, lead 19, nickel 1; for high speed with light to medium loads and generally free from shock; because it has good acid resistance it is particularly suitable for pump bearings and sleeves, and also for electric motor, conveyor and fan, and woodworking machinery bearings.

No. 29; copper 78, tin 7, lead 15; for use where spindle is of soft steel and speed is relatively high; acid resisting alloy.

No. 53; copper 88, tin 10, zinc 2; for severe service or heavy pressures; should be used where shaft is hardened steel and well lubricated.

No. 72; copper 83, tin 7, lead 7, zinc 3; best suited for moderate speeds and low loads.

No. 10 (babbitt alloy); tin 90, antimony 5, copper 5; for thin linings and also may be used in die castings.

No. 11; tin 87, antimony 7, copper 6; rather hard babbitt recommended as lining for connecting rods and shaft bearings subjected to heavy pressures.

No. 12; tin 90, antimony 7.5, copper 2.5; for high speeds and high temperatures.

See advertisement page 8D

K

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KANTHAL—C. O. Jelliff Mfg. Corp., Southport, Conn. An alloy of chromium, aluminum, cobalt and iron made in three grades A-1, A and D for temperatures of 2462 degrees Fahr., 2372, 2102 degrees Fahr. respectively; made in all commercial sizes of round wire and rod, flat ribbon and strip.

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KINITE—H. Boker & Co. Inc., New York. High chromium steel castings and bar steel resistant to abrasion and compression; for dies, cutters, mandrils, and machine parts.

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KLEENKUT—Heppenstall Co., Pittsburgh. Tool steel containing 2 carbon and 12 per cent chromium; for shear knives for cold shearing light material.

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KONAL—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Nickel 72, cobalt 17, titanium 2.2 and iron 6.25; internal combustion engine valves, molds and machine parts subject to stress at temperatures up to 650 degrees Cent.

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KONIK—Continental Steel Corp., Kokomo, Ind. S. A. E. 1010—S. A. E. 1020 plus .1-.3 copper, .3-.4 nickel, .07-.30 chromium; case hardening steel in form of cold drawn wire used for parts subject both to strain and abrasion, such as chains.

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KOVAR—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Low expansion to 400 degrees Cent.; approximately 28.2 nickel, 18 cobalt and 53.8 iron; for gas-tight metal-to-glass seals on radio tubes and similar applications.

- - 3 - - - - - -

KROKOLOY — Detroit Alloy Steel Co., Detroit. Chromium 12 to 14, carbon 1.5 to 1.6, cobalt 1 to 3.5, molybdenum 1; air hardening tool steel castings.

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LEDALOYL—Johnson Bronze Co., New Castle, Pa. Self-lubricating bearing bronze, sintered type; contains lead which eliminates harshness and provides conformability for misalignment; combination of lead and graphite plus oil content make it useful where lubrication is remote or likely to be forgotten.

1 - 3 4 - - - - - -

LEDLOY STEELS—Inland Steel Co., Chicago.

Lead-bearing, free-cutting open-hearth steel; contains about one-quarter per cent lead, which increases machinability about 30 to 50 per cent and tool life approximately 50 to 200 per cent, but has no appreciable adverse effect on physical properties of the steel.

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LIGHTWELD—Lincoln Electric Co., Cleveland; arc-welding electrode made for fabrication of chain and gear guards and other machine parts of light gage steel.

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LO CRO—Crucible Steel Co. of America, New York.

46; chromium 5.

46MO; chromium 5, molybdenum .5.

46W; this and above grades are used widely where high strength at elevated temperatures up to 1200 degrees Fahr. is required.

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LOTUS BABBITT—Lumen Bearing Co., Buffalo. Lead base bearing babbitt.

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LUBRICO—Buckeye Brass & Mfg. Co., Cleveland. Copper 75, lead 20 and tin 5 per cent; for bearings, bushings and bars.

See advertisement page 59D

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LUKENS—Lukens Steel Co., Coatesville, Pa.

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Carbon molybdenum steel; carbon .1 to .3, manganese .4 to .6, molybdenum .6 to 1; tensile strength 70,000 pounds per square inch; welding properties good; recommended for diesel engine housings, etc.

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Silico-manganese steel; carbon .3 max., manganese .6 to .9, silicon .18 min.; plate material of 70,000 pounds per square inch tensile strength; recommended for boiler work.

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Abrasive steel; a carbon-manganese plate steel of 75,000 pounds per square inch tensile strength; recommended particularly for gear rims.

1 - 3 4 - - - - -

Nickel-chrome steel; plate material similar to S.A.E. 3340; 125,000 pounds per square inch tensile strength; recommended for liners and wearing plates.

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Manganese-vanadium steel; carbon .18 max., manganese 1.45 max., vanadium .08 to .12; plate material of 80,000 pounds per square inch tensile strength; recommended for welding structural parts.

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Nickel clad steel; pure nickel bonded to ordinary carbon steel; recommended for vessels, pots, mixers and digesters for resisting alkaline corrosion.

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Inconel clad steel; nickel-chromium alloy bonded to mild carbon steel; recommended for vessels, pots, mixers and digesters subject to alkaline and mild acid corrosion.

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Chrome-manganese steels.

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Welding quality steels including "Weldrite;" low tensile strength.

1 2 - 4 5 6 7 8 9

LUMEN ALLOYS—Lumen Bearing Co., Buffalo.

(Note: "Lumen Alloy," together with each of the following numbers and grades, is a copyrighted term which should be used in specifying these materials. Thus, "Lumen Alloy No. OOA," etc.)

- - - - - 6 - - -

Nos. 00A and 00C; high tin bronzes for high compression bearing applications.

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No. 1; zinc bronze for pressure castings including spur and bevel gears mating with steel.

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No. 2; zinc bronze for machine parts, bearings, etc.

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No. 3; zinc bronze for mine service and paper mill machinery and bearings.

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No. 4; phosphor bronze (leaded), for bearings.

No. 4A; high phosphorus bronze (leaded), for bearings on hard steel.

- - - 4 - - - - -

No. 5; general service casting alloy; red brass; for low pressure valve bodies, etc.

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

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No. 7; phosphor bronze; uses include trolley wheels and castings to be nickel or chromium plated.

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No. 9; manganese bronze for machine parts requiring strength and electrical conductivity.

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No. 11-C; (sand cast) aluminum bronze; for miter, bevel gears and bearings subject to impact.

1 2 . 4 . . . . .

No. 11-C; (heat treated) tensile strength 65,000 to 100,000 lbs. per sq. in.; recommended where strength and corrosion and heat resistance are required.

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No. 14; zinc bronze; babbitt backing; for valve bodies, etc.

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No. 15; phosphor bronze; for worm wheels, bearings, etc.

. . . . . 6 . . .

No. 15A; phosphor bronze (slightly leaded); for worm wheels, bearings, etc.

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No. 20; super-manganese bronze; for machine parts requiring extra strength.

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No. 27; (sand cast) aluminum bronze; for strength and corrosion resistance.

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No. 27; (heat treated) for extreme tensile strength and shock resistance.

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No. 48; nickel phosphor bronze; for bearings used with hardened steel, worm wheels, etc.

. . . . . 6 . . .

No. 54; phosphor bronze (leaded) for bearings and worm wheels for intermediate service.

. . . . . 6 . . .

Old Genuine Babbitt; high strength ingot babbitt for bearings.

. . . . . 6 . . .

Cosmo Babbitt; ingot material for bearings.

. . . . . 6 . . .

Bronze; a zinc base alloy for bearings.

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LXX — Allegheny-Ludlum Steel Corp., Pittsburgh. Carbon, .70, tungsten 18, chromium 4, vanadium 1; for lathe centers for severe service. Oil or air hardening.

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MACALLOY—Vanadium-Alloys Steel Co., Latrobe, Pa.

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No. 1; a chromium-nickel-molybdenum steel containing .35 carbon; tensile strength 200,000 lbs. per sq. in.; recommended for pinions, spindles, cams, clutches, studs, etc.

No. 2; a chromium-nickel-molybdenum steel containing .6 carbon; tensile strength 305,000 lbs. per sq. in.; recommended for spring collets, gears, arbors, races, and pinions.

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MACHEMPITE "Wearprooft" — Mackintosh-Hemphill Co., Pittsburgh. Alloy cast, forged or rolled steel; for gears, locomotive guides, track wheels, sprockets, conveyor parts, etc.

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MACHINEBRONZE—Lumen Bearing Co., Buffalo. Zinc bronze; cored and solid bars for bearings.

. 2 . . . . . .

MACKENITE METAL—Duncan Mackenzie's Sons Co. Inc., Trenton, N. J. For retorts, annealing pots, cylinders, and lead pan castings.

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MAL-ARC—P. R. Mallory & Co. Inc., Indianapolis. A hard-facing material marketed in the form of an electrode; for application to machine parts where abrasion is encountered.

. 2 3 . . . . . .

MALLIX — National Malleable & Steel Castings Co., Cleveland. Pearlitic malleable iron; tensile strength 75,000 lbs. per sq. in., elongation 5 per cent; for grate bars for sintering machines, elevator buckets, screen plates for pan mills and other castings subjected to heat, abrasion and shock.

. 2 . 4 . 6 7 . .

MALLORY—P. R. Mallory & Co. Inc., Indianapolis.

. 2 . . . 6 7 . .

3; an alloy consisting predominantly of copper; used extensively for spot, flash and seam welding cold-rolled steel, stainless steel, nickel alloys and monel metal, silicon bronze alloys, zinc, nickel, silver and other materials employed in numerous applications where a high strength, high conductivity material is required.

. 2 . 4 . . 7 . .

53; copper base alloy furnished in rough and finished bars; tensile strength 90,000 to 100,000 lbs. per sq. in.; used for springs, washers, marine hardware, flash welding dies, bearings and current and heat-carrying members in electrical and other machinery.

73; rough and finished bars and sheets containing 95 per cent copper; resists sea water; 160,000 to 200,000 lbs. per sq. in. tensile strength; used for bearings and bushings, vibrator arms, springs, spring washers and electrodes for projection welding.

100; rough and finished bars containing 95 per cent copper; recommended for high leaded small gears, current-carrying bearings, springs and other details.

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MANGANIN—Wilbur B. Driver Co., Newark, N. J. Copper, nickel and manganese alloy; for shunts, wheatstone bridges, and precision instruments; possesses moderate resistivity, low temperature coefficient.

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MANGANO—Latrobe Electric Steel Co., Latrobe, Pa. Carbon .95, manganese 1.60, chromium .20; used where nonshrinking, oil quenching steel is required.

1 2 3 . . . . . .

MANGANWELD — Lincoln Electric Co., Cleveland. Arc welding electrode that produces deposit of austenitic manganese-nickel-molybdenum steel; suitable for hard facing austenitic manganese steel parts containing 11 to 14 per cent manganese, such as crusher parts, valves, turbine runners, pulverizer roll shafts, gathering and loading equipment.

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MAN-TEN—United States Steel Corp. and subsidiaries (See USS). Carbon .30 max., manganese 1.25 to 1.7, silicon .30 max., copper .20 min.; for use where high strength, abrasion resistance or resistance to severe vibration are necessary.

See advertisement pages 6D-7D

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MASSILLON—Massillon Steel Casting Co., Massillon, O. Alloy cast steel, heat treated; for domestic, industrial and locomotive stoker worms.

1 2 . 4 . . . . .

MAURATH—Maurath Inc., Cleveland; alloy welding rods of many types; each type made especially for use with one of the leading varieties of stainless and heat-resisting steels and with coating of distinctive identifying color, also uncoated electrodes and those of special analyses.

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MAX-EL—Crucible Steel Co. of America, New York.

2-B; carbon .40, manganese 1; used in "as rolled" condition for machine tool spindles, lead screws, racks, worms, piston rods, etc.

3½; for heat treated parts on machine tools, such as gears, arbors, spindles, etc.; also available in a case carburizing type.

1-B; carbon .20, with high manganese and low molybdenum; excellent machining and uniformity in carburizing response; used for automobile parts, machine tool parts, gauges, sprockets, etc.

1 2 3 4 . . . . .

MAYARI—Bethlehem Steel Co. Inc., Bethlehem, Pa.

. 2 3 4 . . . . .

Alloy iron; nickel-chromium-iron available in two grades: Standard Mayari, 0.5 to 3 silicon, and Silvery Mayari, 7.5 to 12 silicon; used for high strength, heat-resistant, wear-resistant castings for cylinder blocks and liners, hydraulic machinery, refrigeration machinery, machine tools, marine engines and valves.

1 . . 4 . . . . .

A; a high tensile atmospheric corrosion-resistant, chromium-nickel-copper-silicon steel; particularly adapted to the manufacture of cars, barges, tanks, stills, structural parts, etc.

Steels; a series of nickel-chromium steels including carburizing and oil hardening grades for shafts, bolts, etc.; a special engine bolt grade is made for locomotive engine bolts and a staybolt grade for locomotive boilers.

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MAZLO Magnesium Alloys — American Magnesium Corp., Cleveland. Characteristics are light weight with mechanical strength and excellent machinability (2/3 that of aluminum); alkali resistant.

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No. AM 240; 90 magnesium, 10 aluminum; furnished in ingot form for sand casting and die casting; for parts of portable equipment and moving machinery where light weight and high strength is important.

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No. AM 265; 6 aluminum, 3 zinc, balance magnesium; furnished in ingots for sand casting; for parts of portable equipment and moving machinery.

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No. AM 230; 10 aluminum, 0.5 silicon, balance magnesium; furnished in ingots for die casting; for moving equipment and portable equipment.

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No. AM 57S; 6 aluminum, 1 zinc, balance magnesium; for use in the form of rods and tubes and for machinery where light weight is important.

No. AM 3S; 1.2 manganese, balance magnesium; furnished in ingots suitable for welding; for aircraft parts such as oil tanks, fuselage partitions and cowlings.

No. AM 58S; 8 aluminum, 1 zinc, bal-

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

ance magnesium; supplied in ingots for hot forgings and hot pressing; for highly stressed parts where lightness is important as in aircraft engines.

No. AM 65S; 3.5 aluminum, 5 tin, balance magnesium; for hot forged parts; highly stressed parts where light weight is important.

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McGILL—McGill Mfg. Co., Valparaiso, Ind.

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Special McGill bronze hydraulic pressure castings; finished casting tolerance of plus or minus .005.

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Permanent mold castings; McGill metal; aluminum bronze alloy suitable for pump liners, gears, corrosion resistant castings and parts requiring strength and toughness with minimum weight.

See advertisement page 63D

- 2 3 4 - - - - -

MEEHANITE — Meehanite Metal Corp., Pittsburgh, and licensees as listed hereunder. A sorbo-pearlitic iron containing silicon, manganese, phosphorus, sulphur and carbon, composition depending upon mixture and physical constitution as determined by service requirements; twelve grades, all of which can be heat treated, each having a separate and distinct combination of physical properties; available in cast form; for important machinery castings.

Licensees include the following: Banner Iron Works, St. Louis, H. W. Butterworth & Sons, Bethayeres, Pa., M. H. Detrick Co., Newark, N. J.; Farrel Birmingham Co., Ansonia, Conn.; General Electric Co., Ontario, Calif.; Valley Iron Works Inc., St. Paul; Greenlee Foundry Co., Chicago; American Laundry Machinery Co., Rochester, N. Y.; Cincinnati Milling Machine Co., Cincinnati, O.; Cooper Bessemer Corp., at Grove City, Pa., and Mt. Vernon, O.; Crawford & Doherty Foundry Co., Portland, Oreg.; Florence Pipe Foundry & Machine Co., Florence, N. J.; The Florence Wehrle Stove Co., Newark, O.; Fulton Foundry & Machine Co., Cleveland; General Foundry & Mfg. Co., Flint, Mich.; Stearns-Roger Mfg. Co., Denver, Colo.; Hamilton Foundry & Machine Co., Hamilton, O.; Kanawha Mfg. Co., Charleston, W. Va.; Barnett Foundry & Machine Co., Irvington, N. J.; Rosedale Foundry & Machine Co., Pittsburgh; Warren Foundry & Pipe Corp., Phillipsburg, N. J.; West Coast Meehanite Metal Corp., Los Angeles; Kinney Iron Works, Los Angeles; Koehring Co., Milwaukee; Marshall Stove Co., Lewisburg, Tenn.; Vulcan Foundry Co., Oakland, Calif.; Atlas Foundry Co., Detroit; Ross-Meehan Foundries, Chattanooga, Tenn.; Washington Iron Works; Seattle; and Peoria Foundry Co., Peoria, Ill.

See advertisement page 67D

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METALINE—R. W. Rhoades Metaline Co. Inc., Long Island City, N. Y. Lubricating insert plugs of several diameters and lengths and in varied compositions for rendering bronze bearings and bushings oilless. Also bronze bearings complete in which Metaline plugs are inserted. Furnished in form of finished bearings.

1 2 - - - - - - -

MICHIANA — Michiana Products Corp., Michigan City, Ind.

No. 48 Alloy; nickel 8, chromium 28.

No. 49 Alloy; nickel 8, chromium 18.

No. 100 Alloy; nickel 12, chromium 24.

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No. 55 Alloy; chromium 33.

No. 63 Alloy; nickel 15, chromium 28.

1 2 - - - - - - -

MIDVALOY — Midvale Co., Nicetown, Pa. Applications to which the following grades are adaptable include machines in the chemical and refining industries, mining and metallurgical work, rolls for paper machinery, impellers for exhaust gases, mechanical stoker parts, hydraulic machinery parts, etc.

13-00 A; chromium 11.5 to 14, carbon .35.

Stainless 7; castings only; chromium 20, carbon .25, copper 1.

13-00; chromium 15 max., carbon .12 or under.

17-00; chromium 15 to 18, carbon .12 or under.

21-00; chromium 18 to 23, carbon .12 or under.

26-02; chromium 27, nickel 2 max., carbon as required.

HR1; chromium 20, nickel 7, carbon .35, tungsten 4.

18-08; chromium 18, nickel 9, carbon .06 up.

25-10; chromium 24, nickel 11, carbon low.

25-10-B; chromium 23, nickel 11, carbon .55.

25-20; chromium 25, nickel 20, carbon low, molybdenum .2.

HY-X; chromium 8, nickel 22, carbon .50, copper 1.

ATV-3; chromium 14, nickel 27, carbon .48, tungsten 3.5.

30-30; chromium 27, nickel 30, carbon low.

17-35; chromium 19, nickel 35, carbon low.

ATV-1; chromium 11, nickel 36, carbon .35.

BTG; chromium 11.5, nickel 60, carbon .30, tungsten 2.5.

976; chromium 9.7, nickel 1.5, aluminum 2.3.

KA2, KA2S, KA2Mo, KNC-3; stainless steel for castings only.

18-08-Se; chromium 18, nickel 9, carbon .10, selenium .24.

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MILL BRASS MIX—E. A. Williams & Son Inc., Jersey City, N. J. Bearings, bushings and mill brasses.

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MIN-OX—The Binney Castings Co., Toledo, O.

Type 51-C; available as sand castings; resists corrosion due to high temperature and oxidizing conditions; resists heat to 1400 degrees Fahr.; high abrasion resistance; tensile strength 55,000 lbs. per sq. in.; good bearing properties; brinell hardness, untreated, 220; used for glass molds, dies for tile pressing, oven enameling racks.

Type DV; available as sand castings; resists corrosion due to high temperatures and oxidizing conditions; resists heat to 1400 degrees Fahr.; tensile strength 90,000 lbs. per sq. in.; good bearing properties; brinell hardness, untreated, 250; used for glass molds, cams, and various machine parts.

Type JR-3; available as sand castings; resists corrosion due to high temperatures and oxidizing conditions; resists heat to 1200 degrees Fahr.; high abrasion resistance; tensile strength 45,000 lbs. per sq. in.; good bearing properties; brinell hardness 240; used for glass molds.

1 2 - 4 - - - - -

MISCO—Michigan Steel Casting Co., Detroit.

Grade A; nickel 35 to 37, carbon .50 to .70, chromium 15 to 17; high load carrying capacity up to 1950 degrees Fahr.; for furnace parts, carburizing boxes, retorts.

Grade B; chromium 24 to 26, nickel 12 to 14, carbon .20 to .30; for furnace parts in sulphurous atmospheres.

Grade B-1; chromium 24 to 26, nickel 12 to 14, carbon .40 to .60; for furnace parts in corrosive atmospheres.

Grade C; chromium 28 to 30; nickel 8 to 10, carbon .20 to .30; for valves, fittings and pump parts for sulphite service.

Grade C1; chromium 28 to 30, nickel 8 to 10, carbon .40 to .60; for high heat furnaces where sulphurous compounds are present.

Grade N; chromium 8 to 10, nickel 20 to 22, carbon .30 to .50; for valve and pump parts where alkali and sea water are encountered; heat resistant up to 1500 degrees Fahr.

Grade HN; nickel 60 to 65, chromium 15 to 18; carbon .60 to .80; for retorts, lead baths, etc.

Grade N-5; nickel 30, silicon 3 to 5, carbon .30 to .50; resistant to sulphuric acid; cast and rolled.

Grade 18-8; chromium 18 to 20, nickel 8 to 10, carbon to suit; for valve and pump parts.

1 2 3 - - - - - - -

Metal; 35 per cent nickel, 15 per cent chromium; for machine parts subject to heat, wear and corrosion, pumps, valves, etc.

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MISCROME—Michigan Steel Casting Co., Detroit.

Grade 1; chrome 16 to 17, carbon .20 to .30; for pump and valve parts; nitric acid resistant and heat resistant up to 1400 degrees Fahr. as in hot oil-handling equipment.

Grade 2; chromium 18 to 23, carbon .20 to .30; possesses high tensile strength; for pump and valve parts; heat resistant up to 1600 degrees Fahr.

Grade 3; chromium 26 to 30, carbon .20 to .30; for severe nitric acid conditions; heat resistant up to 2200 degrees Fahr.; for ore roaster parts, furnace rails, etc.

Grade CR; 14 to 17 chromium, 2 to 3 carbon; heat and abrasion resistant (mild cases); heat resistant up to 1400 degrees Fahr.

Grade KR; chromium 26 to 30 per cent; carbon 2 to 3; abrasion resistant.

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MOCASCO 60—Motor Castings Co., Milwaukee. A dense, high strength, machinable, nickel - chromium - molybdenum gray iron, A.S.T.M. No. 60; minimum tensile strength, 60,000 lbs. per sq. in.; brinell hardness, 228-260; recommended for gears, brake drums, refrigerator, hydraulic and pump castings, etc.

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MOGUL BABBITT—Federal-Mogul Corp., Detroit.

Mogul alloy genuine babbitt; made from tin, antimony and copper, virtually lead free; hard tough alloy; high tensile strength; suitable for die-cast and hand-poured bearings; used for high speed automobile and aircraft engine, steel and bronze back main and connecting rod bearings, trucks, tractors, high speed machinery, planers, and crossheads.

Bearing metal; general all-purpose babbitt for repair and mantenance; for bearings requiring toughness; used for machinery bearings, stationary gas engines, paper mill, rolling mill, rubber plant and brick machinery.

407 nickel babbitt; varying slightly from Mogul genuine babbitt alloy; for applications where speed is fairly high and bearings are large, that is 1/16-inch or more in thickness; used in woodworking machinery and other heavy duty types.

408 special babbitt (copper hardened); originally produced for electric railway armatures, now used for special bearing applications; has great durability and will stand up under hard wear; used in motor pumps, motor shafts, rock crushers and forming presses.

Duro antifriction metal; while softer and less tough than Mogul bearing metal (above), compares favorably with lead base general purpose babbits; used for flour mill, laundry, canning and bottling machinery; pump packing, slow moving pulleys and axle bearings.

Special "B"; a lead and antimony alloy;

free of usual nonbearing ingredients; used for slow speed bearings of all kinds and heavy line shafting.

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MOLYBDENITE—Continental Roll & Steel Foundry Co., East Chicago, Ind. Special chrome molybdenum steel castings for mill pinions, guides and rolls.

- 2 3 4 - - - - -

MO-LYB-DEN-UM — Climax Molybdenum Co., New York. An alloying element for use in steel and iron; imparts strength, toughness, ductility and resistance to abrasion; improves fatigue value, eliminates temper embrittlement, increases physical properties at elevated temperatures; molybdenum steel is easily welded and machined.

See advertisement page 55D

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MOLYBDIE—A. Finkl & Sons Co., Chicago.

Type C; carbon .40, manganese .60, chromium .85, nickel 1.50, molybdenum .30, phosphorus and sulphur .04 max.; for machine parts subject to extreme torsional strains, shock and vibration.

Type R; carbon .31, manganese .55, chromium .75, nickel 1.50, molybdenum .30, phosphorus and sulphur .04 max.; uses are similar to above material.

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MOLY-IRON—Weatherly Foundry & Mfg. Co., Weatherly, Pa. Molybdenum 1, chromium 1 per cent; resists heat up to 1000 degrees Fahr., tensile strength up to 55,000 lbs. per sq. in.; brinell hardness 240; suitable for sand casting subject to heat and abrasion.

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MONEL—International Nickel Co. Inc., New York.

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Type K; nickel 66, copper 29, iron .9, manganese .4, silicon .25, carbon .15, sulphur .005, and aluminum 2.75; for parts requiring strength and corrosion resistance, and those which must be nonmagnetic.

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Type R; nickel 67, copper 30, iron 1.7, manganese 1.1, silicon .05, carbon .1, sulphur .035; recommended for screw machine products and other parts requiring high speed machining.

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Type H; nickel 66, copper 29, iron 1.5, silicon 3, manganese 0.3, carbon 0.2; nonmagnetic material for sand casting requiring strength, hardness and corrosion resistance.

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Type S; nickel 65, copper 29, iron 2, silicon 4, manganese .3, carbon .2; a corrosion-resistant, nonmagnetic material which makes sand casting of high hardness for resistance to abrasion and galling.

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Metal; composition of this alloy is nickel 67, copper 30, balance iron, manganese, silicon, carbon; general purpose alloy for use under corrosive conditions.

See advertisement page 51D

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MORAINE—Moraine Products Div., General Motors Corp., Dayton, O. Rolled bronze split-type bearings and bushings for automobiles, electric motors and farm implements.

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MUELLER 600 BRONZE—Mueller Brass Co., Port Huron, Mich. Copper 60 per cent, zinc .35, other ingredients 5 per cent; for worm gears, connecting rods, seal rings for refrigerators, crankshafts for oil pumps, etc.

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MUNTZ METAL — American Brass Co., Waterbury, Conn., and Chase Brass & Copper Co., Waterbury, Conn. Copper 60, zinc 40; in sheet and tube form.

See advertisement pages 9D-12D

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MUREX — Metal & Thermit Corp., New York. A series of welding electrodes designed for welding carbon-molybdenum steel, Cor-Ten, Mayari and similar steels.

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NA, NA-1, NA-2—National Alloy Steel Co., Blawnox, Pa. Varying percentages of nickel and chromium.

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NACO—National Malleable & Steel Castings Co., Cleveland. Specially processed cast steel; for service where heavy blows and constant friction require a material that combines great strength, toughness and resistance to wear.

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NATIONAL — National Smelting Co., Cleveland. Aluminum alloyed with various hardeners to meet special casting requirements.

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NATIONAL TUBING—National Tube Co., Pittsburgh. Various grades of seamless steel tubing; applications include structural members of machines, etc.

See advertisement pages 6D-7D

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NIAGARA—Niagara Falls Smelting & Refining Corp., Buffalo. A line of alloying elements comprising some three hundred and fifty combinations applicable for deoxidizing and fluxing all types of metals intended for casting, and at the same time providing greater resistance to corrosion and higher pressure qualities such as are encountered in pumps and valves.

1 2 - - - - 7 - -

NICHROME—Driver-Harris Co., Harrison, N. J.; acid and alkali and heat resistant alloy consisting of nickel 60, iron 25, and chromium 15; resists heat up to 2000 degrees Fahr. and is recommended for furnace parts, acid dipping baskets, and filter screen.

Type A; nickel 62, chromium 15; heating element material; also for electrical devices including rheostats, potentiometers, seamless tubing, etc.

Type B; as an addition to cast iron; sold in ratios of 5 and 2½ parts of nickel to 1 part of chromium.

Type V; nickel 80, chromium 20; heating element material; also in sheets for welded tubing, etc.

Cast Nichrome; for furnace parts, pyrometer protection tubes, conveyor castings and carburizing containers. Sheet Nichrome S; sheet; nickel 27, chromium 15, used for various applications.

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NICKEL—International Nickel Co. Inc., New York.

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Type A; nickel 99.4, copper .1, iron .15, manganese .2, silicon .05, carbon .1 and sulphur .005; a corrosion resistant material which resists heat.

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Type D; nickel 95.2, copper .05, iron .15, manganese 4.4, silicon .05, carbon .1, and sulphur .005; furnished in rods, tubing and wire; suitable for parts which must resist effects of products of combustion of gasoline and other fuels at high temperatures.

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Type Z; furnished in rods, wire and strips; suitable for use where exceptional high strength and corrosion resistance are demanded.

See advertisement page 51D

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NICKELDUR — Janney Cylinder Co., Holmesburg, Philadelphia. A nickel bronze; copper 80; lead 10; nickel 5 and tin 5; furnished as centrifugal castings; resists corrosion due to most acids except nitric, alkalies except ammonia; heat resistant to 400 degrees Fahr.; high abrasion resistance; tensile strength 30,000 lbs. per sq. in.; compressive strength 20,000; medium ductility; specific gravity .32 lbs. per sq. in.; very good bearing properties; brinell hardness, untreated, 90; used for pump liners for acid resistance and bushings for heavy bearings.

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NICKELOID — American Nickeloid Co., Peru, Ill. Nickel bonded to zinc, latter serving as rust-proof, flexible and inexpensive white metal base. Available in variety of brilliant finishes and patterns, as sheets, flat strips and coiled strip for continuous feed automatic presses. Can be supplied with quick removable, gum adhered paper covering permitting drawing and forming without marring pre-finish. For tube clips, toys, automotive details and stamped and formed parts demanding bright, permanent finish.

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NICRAL—Nicralumin Co., Jackson, Mich. Complete series of light aluminum alloys in various forms and tempers.

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NICUITE—A. W. Cadman Mfg. Co., Pittsburgh. Nickel bronze; tin 10, nickel 3.5, zinc 2.5, trace of phosphorus, balance copper; high compressive strength for slow or medium speed operation under extreme load pressures.

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NI-HARD—International Nickel Co. Inc., New York, and licensees. Nickel 4.5, chromium 1.5, total carbon 2.7 to 3.6; cast iron for chilled rolls, cement grinding balls, etc., where abrasion is encountered.

See advertisement page 51D

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NIKRO-M — Vanadium-Alloys Steel Co., Latrobe, Pa.; a chromium-nickel-molybdenum steel containing .55 carbon; tensile strength 290,000 lbs. per sq. in.; recommended for collets, races, arbors, and gears.

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NILVAR—Driver-Harris Co., Harrison, N. J.; a 36 per cent nickel steel having the lowest coefficient of expansion up to 392 degrees Fahr. of an alloy; used for thermostatic controls in heating apparatus such as electric ovens, laboratory ovens, gas ovens, oil burners, and house heating apparatus.

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NI-RESIST—International Nickel Co. Inc., New York and licensees. Nickel 14, copper 6, chromium 2, total carbon 2, silicon 1.25 to 2, manganese 1 to 1.5; for castings handling corrosive waters and other solutions, or heats above the range of temperature where ordinary cast iron gives good service; resists corrosive vapors, gases and liquids; recommended instead of plain cast iron under such conditions.

See advertisement page 51D

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NIREX—Driver-Harris Co., Harrison, N. J.; acid resisting material with tensile strength, annealed, up to 95,000 lbs. per sq. in.; spring temper 190,000; supplied in finished rods or bars, wire, sheets and strip; also can be fabricated by sand casting; for use where corrosion and heat resistance, and spring properties will be useful.

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NI-TENSYLIRON — International Nickel Co. Inc., New York, and licensees. Nickel 1 to 4, total carbon 2.50 to 3.15, silicon 1.20 to 2.75, manganese

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

.5 to .9; for machine tool castings, diesel engine housings, auto cylinder blocks, pistons, etc.

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NITRALLOY—Nitralloy Corp., New York, controls nitriding process and licenses under which alloy is produced. A chromium - molybdenum - aluminum steel capable of developing extreme hardness through nitriding; for cams and camshafts, gears, pump parts, splined shafts, cylinder liners, etc. Licensees include Bethlehem Steel Co., Crucible Steel Co. of America, Firth-Sterling Steel Co., Ludlum Steel Co., Vanadium-Alloys Steel Co., Republic Steel Corp., Lebanon Steel Foundry, Empire Steel Castings Co., Massillon Steel Castings Co., Milwaukee Castings Co., Simonds Saw & Steel Co., Timken Roller Bearing Co.

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NITRICASTIRON — Nitricastiron Corp., New York; a cast iron of special compositions for surface hardening by nitriding process; for engine cylinder liners, pump and compressor liners, bushings, oil well equipment, airplane, automotive, tractor and machine tool parts. Licensees are Arcade Malleable Iron Co., Worcester, Mass., Forging and Casting Corp., Ferndale, Mich., Hunt-Spiller Mfg. Corp., South Boston, Mass., and Ludlum Steel Co., Watervliet, N. Y.

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NOGROTH—O & C Co., New York. Castings of alloy iron, nickel and chrome; easily machinable.

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NORDIC IRON—Reading Iron Co., Philadelphia. Special grade of bar iron for service where severe vibration is encountered; applications include hangers, brake rods, clevises, spring bands, etc.

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OILITE—Chrysler Corp. Amplex Div., Detroit, Mich.; Oil cushion, heavy-duty bronze bearings containing one-third oil by volume; used extensively in automobiles, airplanes, farm implements, textile machinery, conveyors, air conditioners, machine tools, household equipment, electric motors, pumps, special machinery, clocks, etc.

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OLYMPIC BRONZE—Chase Brass & Copper Co. Inc., Waterbury, Conn.

Type A; Copper 96, silicon 3, zinc 1; tensile strength 55,000-150,000 lbs. per sq. in.; brinell hardness 70-200; annealed at 1100-1200 degrees Fahr. if necessary to soften for additional cold working; resists corrosion due to saline, acid and alkaline solutions; used for welded structural parts, bolts, nuts, tubing, tie rods, etc.

Type B; Copper 97.5, silicon 1.5, zinc 1; tensile strength 45,000-90,000 lbs. per sq. in.; annealed at 1100-1200 degrees Fahr. if necessary to soften for additional cold working; resists corrosion due to saline, acid and alkaline solutions; used for bolts, nuts, pipe and tubing.

Type C; Copper 94.75, silicon 4.25, zinc 1; for sand castings; tensile strength 40,000 to 50,000 lbs. per sq. in.; brinell hardness 85; resists corrosion due to saline, acid and alkaline solutions; used for corrosion resistant castings.

Type D; Copper 95.6, silicon 3.0, zinc 1, lead 0.4; physical properties same as type "A"; a free machining alloy recommended for bolts, nut and screw machine parts.

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OREIDE—Scovill Mfg. Co., Waterbury, Conn. Copper 90, tin 1 to 2, balance zinc; furnished in finished rods or bars, tubing, wire, sheets and strips (coiled); for stamping, turning, boring, etc., into machine parts; medium abrasion resistance; tensile strength 95,000 lbs. per sq. in. (hard drawn or rolled); specific gravity 8.8; bearing properties fair; electric properties fair; recommended heat treatments, anneal at 525 to 550 degrees Cent.; spring properties good; used primarily for spring contacts and switch parts.

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OXWELD—Linde Air Products Co., New York.

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No. 1; welding rod for steel giving welds of high tensile strength.

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No. 7; chrome iron welding rod giving welds of high tensile strength.

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No. 23; welding rod for aluminum giving corrosion resistance and high tensile strength.

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No. 25M; welding rod for bronze having brinell hardness of 96 and tensile strength of 55,000 pounds per square inch.

No. 28; a columbium bearing welding rod suitable for 18-8 stainless steel.

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PERDURO—The Jeffrey Mfg. Co., Columbus, O. High-strength malleable iron for sand casting; resists corrosion due to analysis and heat treatment; resists heat up to 1100 degrees Fahr.; high abrasion resistance; tensile strength 80,000 lbs. per sq. in.; used for cast chains for drive and conveyor service.

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PERMITE—Aluminum Industries Inc., Cincinnati. Following grades available as sand castings, gravity die castings and ingots.

1 2 - 4 - - - - -

No. 1002; copper 10, iron 1.50, magnesium 40, balance aluminum; for pistons for automotive, pump and refrigeration service.

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No. 1010; copper 4, silicon 1, balance is aluminum; for machine parts to resist shock; heat treatment is to soak at critical and quench in water, and reheat at 350 degrees Fahr. to desired properties.

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No. 1019; furnished in ingots and sand casting; silicon 5, copper 1.25, magnesium .50, balance aluminum; heat treatment, quenching in water; suitable for highly stressed parts including airplane engine parts.

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No. 2011; silicon 5, balance aluminum; for parts subject to atmospheric corrosion.

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No. 2021; magnesium 4, balance aluminum; for parts subject to salt water corrosion.

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PERMOLD—Permold Co., Cleveland. Permanent mold aluminum castings. Applications include parts for washing machines, vacuum cleaners, typewriters, automobiles, etc.

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PHOS-COPPER—Westinghouse Electric & Mfg. Co., East Pittsburgh; rod and strip material containing 5 phosphorus and balance copper; giving high corrosion resistant and strong joints when brazing assemblies of copper and copper alloys to each other.

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PIONEER METAL — Pioneer Alloy Products Co. Inc., Cleveland. Approximately 65 nickel, chrome and molybdenum; castings; readily machinable.

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PMG METAL—Phelps Dodge Copper Products Corp., New York. High-tensile silicon bronze having high strength and hardness, low coefficient of friction, resistance to impact, etc.; produced in form of rods, wire, tubing, strip, sheet, sand castings, die castings and centrifugal castings; used for pump shafting, rods, bolts, nuts and rivets, valve parts, gears, bearings, spindles and rigid conduit and electrical metallic tubing.

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POMPTON — Allegheny - Ludlum Steel Corp., Pittsburgh. Carbon, .95-1.05; for arbors, bushings, collets and lathe centers. Water hardening.

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PRECISION—Precision Castings Co. Inc., Syracuse, N. Y.

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Type A-12; aluminum base alloy; silicon 12, balance aluminum; resists heat up to 1000 degrees Fahr., tensile strength 33,000 lbs. per sq. in.; specific gravity 2.66; for general aluminum die casting uses.

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Type ZN-5; aluminum 4, copper 1, and balance zinc; tensile strength 42,000 lbs. per sq. in.; compressive strength 85,000; specific gravity 6.71; brinell hardness 75; for general die casting uses—automotive, washing machines, electrical equipment, etc.

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Type ZN-6; aluminum 4, balance zinc; tensile strength, 36,000 lbs. per sq. in.; compressive strength, 60,000; specific gravity 6.60; brinell hardness 65; for automotive and electrical equipment, washing machines, and miscellaneous mechanical parts.

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PROFERALL—Campbell, Wyant & Cannon Foundry Co., Muskegon Heights, Mich. Electric furnace high test cast iron, low carbon; chrome nickel molybdenum alloyed; for crankshafts and camshaft castings, high strength heat, resisting castings, hydraulic press and pressure castings, etc.

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PROMAL — Link-Belt Co., Indianapolis. Specially processed malleable iron; will withstand heavy loads without permanent distortion; where additional corrosion resisting properties are desired small percentages of copper can be added; can be hot-dip galvanized and will withstand repeated heating and cooling without growing brittle; uses include chain links, bearing caps, rocker arms, gears, sheaves, levers, and other machine parts subjected to severe service.

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PYRASTEEL—Chicago Steel Foundry Co., Chicago. Nickel varies from 8 per cent up, chrome from 8 to 26 per cent; available as castings for heat treating furnaces, screw conveyors, or any high temperature service up to 2200 degrees Fahr.

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PYROCAST — Pacific Foundry Co., San Francisco, Calif. A chrome-nickel-iron resistant to high temperature.

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

1 2 - - - - - - - -

PYRODIE — Heppenstall Co., Pittsburgh. Nickel chrome-molybdenum-steel, .6 carbon; for insert and hot die steel service.

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PYTHON—Allegheny-Ludlum Steel Corp., Pittsburgh. Carbon, .85, vanadium .25; for chuck jaws, clutch pins and other parts requiring unusual wear and shock resistance. Water hardening.

Q

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Q-ALLOYS—General Alloys Co., Boston.

CN-1; chrome 22 to 26; nickel 10 to 12; resists corrosion due to attack from most all common acids and gases; brinell hardness 160 to 200 untreated; resists heat up to 2100 degrees Fahr.; has tensile strength of 75,000 to 95,000 lbs. per sq. in.; used for machine parts where corrosion resistance is desired.

CN-2; chrome 17 to 21, nickel 7 to 9; resists general corrosion; brinell hardness 160 to 200 untreated, 160 to 200 heat-treated; resists heat up to 2100 degrees Fahr.; has tensile strength of 70,000 to 80,000 lbs. per sq. in.; same use as above.

CN1-H; resists heat and corrosion; has tensile strength of 80,000 lbs. per sq. in.; for castings subject to temperatures up to 2100 degrees Fahr.

CN1-MO; same data as for CN-1, except that it contains 1 to 4 per cent molybdenum.

CN2-MO; same data as for CN-2, except that it contains 1 to 4 per cent molybdenum.

Chrome C1; chrome 25 to 30, nickel 3 max.; resists corrosion due to mine water.

Chrome C2; resists corrosion due to nitric acid; used for machine parts where corrosion resistance is desired.

Chrome C3; resists heat up to 2000 degrees Fahr.; brinell hardness over 500 untreated; used for mill guides and any part requiring resistance to abrasion at high temperatures.

Grade A; resists heat up to 2200 degrees Fahr.; nickel 65 to 68, chrome 15 to 19; tensile strength approximately 70,000 to 80,000 lbs. per sq. in.; annealing to remove casting stresses only; for machine parts requiring high temperatures up to 2200 degrees Fahr.

Grade B; approximately 60 nickel, 12 chromium; resists heat up to 2200 degrees Fahr.; tensile strength is approximately 65,000 to 75,000 lbs. per sq. in.; for use where temperatures up to 2200 degrees Fahr. are required.

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RED ANCHOR—Anchor Drawn Steel Co., Latrobe, Pa. Carbon .95 to 1.10; commercial carbon drill rods; for precision shafts for motors, spindles, anvils and dental tools.

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RELLEUM BRASS—Mueller Brass Co., Port Huron, Mich. Copper 59, lead 2 and zinc 31; recommended particularly for parts of forged brass.

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RESISTO-LOY—Resisto-Loy Co., Grand Rapids, Mich. A hard-surfacing alloy for application by electric arc or acetylene torch to shovel teeth, third rail shoes, agricultural machinery parts, etc.

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REZISTAL—Crucible Steel Co. of America, New York.

Stainless irons; No. 12; 10 to 13.5 chromium. No. 17; 16 to 18 chromium. No. 20; 18 to 23 chromium. No. 27; 23 to 30 chromium. No. 162; 16 chromium, 2 nickel. No. 182; 18 chromium, 2 nickel. All have .12 max. carbon except No. 27 with carbon .25 max.

Stainless Steels; a group similar to the foregoing except having a higher carbon content; used principally for bearings, cutlery, etc., where hardness and resistance to corrosion are desired.

Stainless A; .3 carbon, 12 chromium. B; .60 carbon, 16 chromium. B-100; 1 carbon, 17 chromium.

KA-2 (chromium 18, nickel 8) and its modifications. No. 3; chromium 22, nickel 12. No. 4; chromium 20, nickel 25, silicon 2.50. No. 7; chromium 25, nickel 20. No. 2600; chromium 8, nickel 22, copper 1.25.

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RITA—Cannon-Stein Steel Corp., Syracuse, N. Y.

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No. 2; carbon .20, manganese 1.15, phosphorus and sulphur .05 max., nickel .50, chromium .30; brinell hardness untreated 174, heat treated 388; carburizing 1650 degrees Fahr. and for toughening at 1550 to 1575 degrees Fahr.; resists corrosion, due to chromium and nickel content; resists heat up to 500 to 600 degrees Fahr., and has tensile strength of 85,000 as rolled; for general machinery purposes where a free cutting uniform material of great strength and toughness is desired.

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No. 4; carbon .4, manganese .9, phosphorus and sulphur .08, chromium and nickel .5 max., brinell hardness untreated 223, heat-treated 461; recommended heat treatment, oil quenching, 1475 degrees Fahr.; resists corrosion due to chromium and nickel content, resists heat up to 900 degrees Fahr. and has tensile strength of 105,000 pounds as rolled. Recommended for spindles and shafts, toughness being reduced to render more readily machinable.

No. 5; carbon .50, manganese 1.20, phosphorus and sulphur .05 max., nickel .50 max., chromium .60; brinell hardness untreated 269, heat treated 627, recommended heat treatment for oil quenching is 1500 to 1525 degrees Fahr.; resists corrosion due to chromium and nickel content; resists heat up to 900 to 1000 degrees Fahr.; tensile strength of 130,000 pounds as rolled; for gears, jaws, studs, bolts, axles, etc.

No. 7; carbon .65, manganese .50, phosphorus .045 max., sulphur .05 max., chromium .60, nickel 1.25; brinell hardness untreated 179 to 223, heat treated 653; recommended heat treatment, water quenched, at 1425 to 1450 degrees Fahr.; oil quenched, at 1450 to 1475 degrees Fahr. Resists corrosion, due to nickel and chromium content; resists heat up to 700 to 800 degrees Fahr.; tensile strength 135,000 lbs. per sq. in. as rolled; for expander and dowel pins, vise and wrench jaws, pneumatic hammer pistons, etc.

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RIVERSIDE—Riverside Metal Co., Riverside, N. J.

Beryllium copper; heat treatable copper alloy; has high tensile strength and ductility; for electrical parts, springs, diaphragms, jet tips, valve sleeves and seats, etc.

Phosphor bronze; copper tin alloy to which phosphorus has been added; has high strength and ductility; used in electrical appliances and machinery as springs, bearings, diaphragms, textile ring travelers, etc.

Nickel silver; copper, nickel, zinc in varying proportions; for diaphragms, radio and telephone springs, screw machine products, etc.

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ROL-MAN—Manganese Steel Forge Co., Philadelphia. Furnished in rods or bars, wire, sheets and plates, for hot forging, stamping, welding, grinding (including threading) and weaving into parts; contains manganese, 11 to 14; carbon 1.10 to 1.40; resists heat up to 400 degrees Fahr.; has high abrasion resistance; tensile strength 140,000 to 160,000 lbs. per sq. in.; compressive strength 100,000; high ductility; nonmagnetic; brinell hardness, heat treated, 190 to 210; used where parts are subject to abrasion and need high strength.

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ROMAN BRONZE — Revere Copper & Brass Inc., New York. Copper 60, tin .75, zinc 39.25; for forging, flanging, upsetting; uses include piston rods, shafting, bearing applications, etc.

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RUSTLESS—Rustless Iron & Steel Corp., Baltimore.

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13-HC-35, type 420; carbon .40 max., chromium 12 to 14; hardening type of stainless steel; brinell hardness 550; used for valve parts, knife blades, abrasion and corrosion resisting machine parts.

17-HC-90, type 440; carbon .60 to 1.00, chromium 14 to 18; hardening type of stainless steel; brinell hardness 625; used for same type of machine parts as type 420.

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25-12, type 309; carbon .20 max., chromium 22 to 26; nickel 12 to 14; highly resistant to heat and creep up to 1300 degrees Fahr., scaling up to 2000 degrees Fahr.; resists nitric-sulphuric acid mixtures and sulphite liquors; used for furnace parts and for parts where corrosion conditions are severe.

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RUSTLESS 17—Rustless Iron & Steel Corp., Baltimore.

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Type 430; carbon .12 max. and chromium 14 to 18; resists sulphur gases, nitric, and organic acids; for corrosion resisting rivets, screws, bolts and other parts.

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Type 430F; carbon .12 max., sulphur .15 min. and chromium 14 to 18; free cutting stainless steel which resists heat up to 1450 degrees Fahr.; has tensile strength up to 85,000 lbs. per sq. in.

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SABECO — Fredericksen Co., Saginaw, Mich.

No. 5 bearing bronze; copper 69 to 71, tin 4.5 to 5.5, lead 24 to 26, max., impurities .2; for light or medium load and water lubricated bearings.

No. 9; copper 69 to 71, tin 8.5 to 9.5, lead 20 to 22, max., impurities .2; for heavy loads such as average machine tool requirements.

No. 11; copper 69 to 71, tin 10.5 to 11.5, lead 18 to 20, max. impurities .2; for extra heavy unit pressures.

No. 11HG; copper 69 to 71, tin 10.5 to 11.5, lead 18 to 20, max. impurities .2; for worm wheels, clutch shifter shoes, forging machine slides, etc.

No. 16; copper 69 to 71, tin 15 to 17, lead 13 to 15, max. impurities .2.

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SAMSON—The Carpenter Steel Co., Reading, Pa.

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No. 5-317; chrome nickel steel; carbon .50, nickel 1.75, chromium 1; for gears, clutches and shafts.

No. 5 Samson; carbon .50, nickel 1.25, chromium .60; for gears and clutches.

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

No. 4-408; carbon .40, nickel 3, chromium .75; for clutches and shafts.

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No. 158; carbon .10, nickel 3.50, chromium 1.50; for case hardened high duty clash gears, shafts, clutch parts.

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No. 4 Samson steel; carbon .40, nickel 1.25, chromium .60; for side links of silent chains, shafts, axles, etc.

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No. 2 Samson; carbon .20, nickel 1.25, chromium .60; for gears, roller bearings, pneumatic tool parts, etc.

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No. 3-547; nickel steel; carbon .30, nickel 3.50; for heat treated shafts, etc.

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No. 2-547; case hardening nickel steel; carbon .20, nickel 3.50; for small parts requiring hard surface and tough core.

No. 500; carbon .10, nickel 5; for turbine blades, case hardened gears, etc.

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Chrome Vanadium 5-720; carbon .50, chromium .90, vanadium .20; for leaf and coil springs, gears, shafts, etc.

No. 3-427 chrome molybdenum steel; carbon .30, chromium 1, molybdenum .20; for aircraft and automotive parts.

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No. 436; carbon .15, nickel 1.75, molybdenum .25; for case hardened parts.

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SANDUSKY ALLOY IRON — Sandusky Foundry & Machine Co., Sandusky, O. Nickel, chrome and molybdenum cast iron alloys; furnished in tubing, centrifugally cast and in finished cylindrical parts; resists corrosion; high abrasion resistance; tensile strength 25,000 to 60,000 lbs per sq. in.; brinell hardness, untreated, 160 to 300; heat treated, 300 to 600; used for rolls, liners, sleeves, bushings, cylinders, pipes and tubes.

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SANDUSKY BRONZES—Sandusky Foundry & Machine Co., Sandusky, O. Bronze, brass and manganese bronze alloys; furnished in tubing, centrifugally cast and in finished cylindrical products; resists corrosion due to composition and superior structure; tensile strength 30,000 to 110,000 lbs. per sq. in.; good bearing properties; brinell hardness, untreated, 40 to 250; used for rolls, liners, sleeves, bushings, cylinders, pipe, tubes of 3 to 46 inches in diameter and 330 inches in length.

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SATCO—National Lead Co., New York. White metal bearing alloy; high melting point; nondeforming; suitable for die casting; primary application is bearing liners.

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SCOVILL HARDWARE BRONZE—Scovill Mfg. Co., Waterbury, Conn. Copper 89, lead 2, nickel 1, balance zinc; furnished in rods, bars and wire for turning, boring, etc.; machinability good; resists corrosion due to atmospheric conditions; tensile strength 38,000 to 85,000 lbs. per sq. in.; specific gravity 8.85; bearing properties good; recommended heat treatment, annealing, 1000 to 1100 deg. Fahr.; brinell hardness, untreated, 48 to 125; used for hardware and screw machine products.

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SEMINOLE — Allegheny-Ludlum Steel Corp., Pittsburgh. Carbon, .45, chromium 1.30, tungsten 2, vanadium .25; for high creep strength bolts and studs for superheated steam; also machine parts having high wear and fatigue values. Withstands moderately elevated temperatures (up to 110 deg. Fahr.). Oil hardening.

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SEYMOUR—Seymour Mfg. Co., Seymour, Conn.

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Nickel silver, grade A; nickel base alloy which is corrosion resistant and has a tensile strength up to 100,000 lbs. per sq. in.

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Phosphor bronze, Grade A; brinell hardness 160 and tensile strength 105,000 lbs. per sq. in.

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Phosphor bronze, grade C; brinell hardness 175; tensile strength 112,000 lbs. per sq. in.

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SEYMOURITE—Seymour Mfg. Co., Seymour, Conn. Copper 64, nickel 18, zinc 18.

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SHAWINIGAN — Shawinigan Chemicals Ltd., Montreal, Que., Canada.

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Type KA2MO; carbon .15, chromium 20 nickel 9 and molybdenum 3; an acid resisting alloy with tensile strength up to 100,000 lbs. per sq. in., brinell hardness 185.

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Heat resisting; carbon .3, chromium 28, and nickel 15; tensile strength 90,000 lbs. per sq. in.; brinell hardness of 200; resists heat up to 2000 degrees Fahr.

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Stainless and Heat Resisting Steel; chrome nickel steel; for application where corrosion and heat are encountered.

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SHIELD-ARC—Lincoln Electric Co., Cleveland.

Type 8.5; high tensile welding rod; recommended for fabrication of high tensile steels; brinell 190 to 250.

Type 100; brinell hardness 235 to 300.

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SHOCK PROOF—Lake City Malleable Co., Cleveland. Malleable iron of high tensile strength, high yield point and ability to withstand considerable shock loading and abuse, at the same time possessing good machining qualities; for cast parts to resist heavy strains, shocks and corrosion.

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SICROMO STEEL—Timken Steel & Tube Div. The Timken Roller Bearing Co., Canton, O. Carbon, .15 max., manganese .50 max., silicon .50 to 1.00, chrome 2.25 to 2.75, molybdenum .40 to .60, suitable for cracking furnace tubes, high temperature heat exchangers etc.

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SIL-FOS—Handy & Harman, New York. Brazing alloy containing silver 15, copper 80, phosphorus 5; furnished in rods or bars, wire, sheets and strips (coiled); corrosion resistant; high ductility; specific gravity 8.45; used to join nonferrous metals only, particularly copper, brass and bronze.

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SILFRAM—Stoody Co., Whittier, Calif.; a hard-facing metal designed for application to parts subject to corrosion, abrasion and impact.

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SIL-TEN—United States Steel Corp. and subsidiaries (See USS). Carbon .40 max., manganese .60 min., silicon .20 min.; used in the design of machinery.

See advertisement pages 6D-7D

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SIMPLEX—Crucible Steel Co. of America, New York. Nickel 1.25, chromium .75; forging steel for machine parts requiring high strength and toughness; also available in case carburizing type.

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SIVYER—Sivyer Steel Castings Co., Milwaukee.

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"Sixty"; chromium 18, nickel 8, carbon .12 max.; an austenitic nonhardenable corrosion resistant cast steel; also non-magnetic.

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"Sixty-four"; chromium 27, nickel 10, carbon .25 max.; characterized by high strength and better corrosion resistance than "Sixty."

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"Sixty-six"; chromium 11.5 to 13.5, carbon .12 max.; hardenable cast steel of medium corrosion resistance. Five per cent chrome moly—a 5 per cent chromium, .5 molybdenum steel, for oil refinery and power plant service.

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"Seventy"; chromium 15, nickel 35.

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Hi-carbon chrome moly; a 70 per cent chrome molybdenum air hardening cast steel for severe abrasion; for rolling mill rolls, wearing plates, etc.

6140; fine grained cast chrome vanadium steel for road machinery or excavator teeth, etc., combining abrasion resistance with good ductility.

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3140; chrome nickel general purpose steel; composition properly balanced for liquid quenching.

Miraculoy; chrome nickel manganese molybdenum steel having high physical properties after air or oil quenching and tempering.

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Manganese nickel; manganese 1.2, nickel .75; suitable for differential water quenching.

Manganese vanadium; manganese 1.25, vanadium .10; cast steel with combination of strength and ductility.

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Dynamo; a low carbon, low manganese steel with low residual magnetism.

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SMITH DYNAMO STEEL—Smith Steel Foundry Co., Milwaukee; steel for sand castings containing carbon .10 and having a high degree of magnetic permeability; recommended for electro magnets, pole pieces and motor frames.

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STANDARD-ALLOY—Standard Alloy Co., Cleveland. Nickel 20 to 60, chromium 16 to 25 per cent; for heat and acid resisting castings.

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STANNUM BABBITT—Lumen Bearing Co., Buffalo. Tin base bearing babbitt.

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STERLING Stainless Steels—Firth-Sterling Steel Co., McKeesport, Pa.

1 - 3 4 - - - - - -

Type A (420); carbon .35, chromium 13.5; corrosion resistant; tensile strength of 240,000 lbs. per sq. in.; for ball bearings and automotive parts where wear is effected.

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Type T (410); carbon .1, chromium 13; possesses maximum strength and elasticity without sacrifice of tough-

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

ness; machinable and corrosion resistant; for pump rods, shafts, valve parts, gun barrels, pistons and machinery parts where strength is of greater importance than ease of machining.

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Type TX (403); modified Type T used for turbine blading.

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Type FC (416); free cutting stainless steel wherein a slight sacrifice in physical properties and corrosion resistance is made to obtain easier machining; for machine parts including screws, bolts, nuts, pump shafts, valves and spindles.

1 - - 4 5 - - - -

Nirosta, Types KA2, KA2-FC, KA2S and 19-9; of the 18-8 chrome-nickel group containing approximately 18 per cent chromium and 8 per cent nickel with various modifications or additions to give special physical properties, machinability or resistance to certain corrosive action; the free cutting type can be easily machined, and cold work-hardened wire and strip have great strength and resiliency.

Type A (420); good physical properties in heat treated state; maximum resistance to corrosion secured by hardening and through grinding; for wear resisting parts.

Type T (410-425); carbon .10, chromium 13; brinell hardness 165 untreated and 400 heat treated; high tensile strength type; for valves, trim, pump rods, pistons, etc.

Type TX (403); developed for turbine blading.

Type M (430); soft ductile steel that does not work-harden readily; requires no heat treatment to secure corrosion resistance.

Type MG (442); used where strength and toughness are secondary to workability and high temperature resistance.

Type KA2 (302); an 18-8 steel; used particularly in oil and chemical industries; in hard wire this material is especially suitable for springs.

Type FC (303); free machining 18-8 steel.

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STOODITE—Stoody Co., Whittier, Calif. A hard-facing metal used chiefly as overlay on earth working equipment.

1 2 3 - - - - - -

STOODITE (Numbered) — Stoody Co., Whittier, Calif.; include Stoodite "45," "54" and "63," which range in physical properties from extreme hardness to extreme toughness. Rockwell "C" hardness indicated by numbers; designed for applications involving heat, corrosion, impact or abrasion.

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STOODY (Self-Hardening)—Stoody Co., Whittier, Calif.; a hard-facing metal used chiefly as an overlay on earth working equipment.

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SUMET—Sumet Corp., Buffalo.

SM-4; lead 28 per cent; for light and medium duty bearings in high speed service.

SM-8; lead 26; for moderately severe service.

SM-10; lead 24; for bearings subject to shock and impact.

SM-12; lead 22; for slow speed under heavy load and impact.

SM-14; lead 14; for severe service subjected to heavy shock.

SM-16; lead 20; for heavy duty slow speed service.

SM-18; lead 17½; for extremely severe service; uses include roll neck bearings; also suitable for gear blanks.

1 - - 4 - - - 8 -

SUMMERILL — Summerill Tubing Co., Bridgeport, Pa. Seamless tubing in practically all regularly used carbon grades from SAE 1010 to SAE 1.00. Others are chrome molybdenum SAE 4130X, 4140, 4150, 4185, 52,100, 4340; nickel silver, pure nickel silver, corrosion resistant steels—18-8, 16-13-3 and similar grades; 4 to 6 per cent chrome with ½ moly; also some of 12 to 14 per cent chrome.

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SUPARD-CROME—Janney Cylinder Co., Holmesburg, Philadelphia. Centrifugal castings. A special chromium steel which resists corrosion due to sulphur acids and most corrosive solutions; heat resistant up to 900 degrees Fahr.; high abrasion resistance; tensile strength 196,000 lbs. per sq. in.; compressive strength 100,000; ductility low; specific gravity .28 lbs. per cu. in.; good bearing properties; brinell hardness, untreated, 200, heat treated, 550 plus; used for pump liners, sleeves for plungers, shaft sleeves for centrifugal pumps, bushings and wear rings.

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SUPERIOR STAINLESS—Superior Steel Corp., Carnegie, Pa.

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Type 410; chromium 10 to 13.5, carbon .12 max.

Type 430; chromium 14 to 18, carbon .12 max.

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Type 301-X; chromium 16 to 17.5, nickel 7 to 8.5, carbon .10 to .20.

Type 302; chromium 17.5 to 19, nickel 8 to 9, carbon .08 to .20.

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SUPERLOY — Washington Iron Works, Seattle, Wash.

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Manganese steel; abrasion resistant steel castings.

No. 10; high carbon chrome nickel molybdenum steel; abrasion resistant steel castings.

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No. 4; chrome nickel molybdenum steel; high tensile strength steel castings.

1 - 3 - - - - - -

SUPERMAL — The Jeffrey Mfg. Co., Columbus, O. High strength malleable iron; resists heat up to 400 degrees Fahr.; high abrasion resistance; tensile strength 70,000 lbs. per sq. in.; medium ductility; brinell hardness, heat treated, 180 to 200; used for cast chains for drives and conveyor service.

- 2 - 4 - - - - -

SUPERTEMP—Bethlehem Steel Co., Bethlehem, Pa. A patented alloy steel having high tensile strength at high temperatures; suitable for bolts and studs for reaction chambers, cracking stills, superheaters, etc.

SWEETALOY—(See Cooper Alloy).

T

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TALIDE—Metal Carbides Corp., Youngstown, O. Tungsten carbide metal; resists corrosion due to high tungsten content; heat resistant to 2000 degrees Fahr.; high abrasion resistance; tensile strength 300,000 lbs. per sq. in.; specific gravity 14.1; brinell hardness, untreated, 130 and over; for use as wear plates and guides, cutting tools, drawing dies and bushings.

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TAMCO—Titanium Alloy Mfg. Co., Niagara Falls, N. Y. Alloys including original high and medium carbon ferro carbon-titanium, foundry ferro titanium, and several varieties of low carbon ferro titanium for rolled, cast and forged steels, stainless and alloy steels, and gray cast iron. For the nonferrous field, alloys include TAM Webbite (alumino-titanium) for aluminum castings, cupro-titanium for copper, nickel-titanium, molybdenum-titanium, and special alloys for special purposes, in addition to metallic titanium and metallic zirconium.

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TANTALUM BRONZE — Ruselite Corp., Milwaukee; aluminum 10, molybdenum .6, tantalum .20 and balance copper; tensile strength 72,000 to 120,000 lbs. per sq. in.; recommended where extremely high tensile bronze is required.

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TEMP ALLOY—Continental Roll & Steel Foundry Co., East Chicago, Ind. Chrome alloy heat resisting cast iron used for furnaces and other designs subject to high temperatures and abrasion.

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TEMPALOY—American Brass Co., Waterbury, Conn. Copper aluminum and nickel alloys which yield to heat treatment; uses include motor boat shafting, piston rods, etc.

See advertisement pages 9D-12D

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TETON—Allegheny-Ludlum Steel Corp., Pittsburgh. Carbon 1, chromium 1.40; for balls and ball races, bushings, cams, etc. Usually hardened in oil.

1 2 - - - - - - - -

THERMALLOY — Electro-Alloys Co., Elyria, O.

Grade A; 64 to 66 nickel, 17 to 20 chromium.

Grade 72; 58 to 62 nickel, 12 to 15 chromium.

Grade B; 38 to 42 nickel, 16 to 19 chromium; for rollers, chain, skid rails and disks.

Grade 50; 33 to 37 nickel, 14 to 16 chromium.

Grade C; under 2 nickel, 25 to 30 chromium; used in chemical industry for rabble arms, etc.

Grade D; 2 to 5 nickel, 25 to 30 chromium.

Grade E; 8 to 12 nickel, 24 to 28 chromium.

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THERMOMETAL—The H. A. Wilson Co., Newark, N. J. Thermostatic bimetals furnished in strips and formed parts for temperature control and temperature compensation.

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TIGERLOY—Massillon Steel Casting Co., Massillon, O. Nickel-molybdenum; for shovel castings, gears, crane track wheels, castings for impact resistance, etc.

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TIMANG—Taylor-Wharton Iron & Steel Co., High Bridge, N. J. Nickel manganese steel; can be rolled, drawn, forged or shaped; for journal box liners, pedestal gib liners, conveyor flights, welding rod, etc.

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TIOGA—Allegheny-Ludlum Steel Corp., Pittsburgh. Carbon .67, manganese .60, chrome .65, nickel 1.40, molybdenum .20; combines good degree of hardness and toughness with fair nondeforming quality; oil hardness; used for lathe centers, clutch parts, rivets, cams, arbors, spindles, gears, shafts, tool posts, etc.

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TISCO—Taylor-Wharton Iron & Steel Co., High Bridge, N. J.

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Stainless steel castings of all compositions, including chrome-molybdenum,

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

nickel - chrome - molybdenum, 18 - 8 chrome-nickel, and high chromium.

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Manganese steel castings for shock and abrasion resistance.

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TOBIN BRONZE — American Brass Co., Waterbury, Conn. Copper 60, zinc 39.25, tin .75; uses include piston rods, boat shafting, condenser head plates, welding rods, seamless tubes, etc.

See advertisement pages 9D-12D

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TOLEDO ALLOY—Industrial Steel Casting Co., Div. of Unitcast Corp., Toledo, O.

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No. 3; carburizing steel, heat treated to give good machinability and uniform grain; excellent results obtained with short cycle carburizing treatment.

No. 4; abrasion resistant silicon-molybdenum steel with good hardening properties; used for mining tools, wear plates, crusher plates and pinions.

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No. 6; air hardening die steel of uniform machining qualities; long life under severe wear.

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No. 7; triple heat treated carbon vanadium steel for many applications in the railroad and locomotive industry where extensive and repeated stress is encountered.

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No. 8; pearlitic manganese steel with analysis adjusted to give high tensile strength and ductility; used in automotive and aircraft equipment and other machines. Adaptable to flame hardening for selective treatment and oil hardening for complete quenching treatment.

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TONCAN IRON—Republic Steel Corp., Cleveland. An open hearth iron alloyed with .40 min. copper and .05 min. molybdenum; resists corrosion due to atmosphere, water, oils and process materials; tensile strength 50,000 lbs. per sq. in., min.; compressive strength 40,000; brinell hardness 110; for housing, piping, tubing, etc.

1 2 3 - - - - - -

TOOLWELD—Lincoln Electric Co., Cleveland. Coated arc welding electrode providing a deposit with hardness of 683-71 brinell; hardness retained up to 1000 degrees Fahr.; deposit can be heat treated same as high speed steel; for building hard, tough cutting edges on cold rolled steel and for other applications requiring superhardness.

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TOPHET—Wilbur B. Driver Co., Newark, N. J.

Type A; approximately 80 per cent nickel and 20 chromium; resists heat up to 2100 degrees Fahr.; supplied in wire and strip form for electrical heating applications.

Type C; nickel, chromium and iron; resists heat up to 1900 degrees Fahr.; supplied in wire and strip form; for electrical resistance and heating applications; heat resistant.

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TRODALOY No. 1—General Electric Co., Schenectady, N. Y. Resistance welding electrode alloy containing 2.6 per cent cobalt, .4 beryllium, 97 copper, has 55 per cent conductivity of copper; 45,000 lbs. per sq. in. proportional limit; 220 brinell hardness; used for switch blades, cams, spring fingers, etc. Licensees are: Riverside Metal Co., P. R. Mallory Co., Ampco Metal Co., and Electroloy Co.

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TRUALOY—True Alloys Inc., Detroit.

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Copper; has high conductivity; castings for welding machines and conduction of current.

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Bearing bronze; low friction and wear, with high compressive strength; resistant to pounding and easy to machine.

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Aluminum; castings possessing strength, hardness and lightness.

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Aluminum bronze, for sand castings having corrosion resistance and tensile strength of 65,000 lbs. per sq. in.; recommended for parts subject to strain and wear.

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TUF-STUF — Mueller Brass Co., Port Huron, Mich. Copper 87 per cent, iron 3, aluminum 10; for application where high tensile strength, resistance to abrasion and to sulphuric acid are required.

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UMA—Union Drawn Steel Div., Republic Steel Corp., Massillon, O. Free-machining steels; through the application of the Uma treatment abrasive inclusions which destroy tool life are eliminated to a degree that permits higher speeds and greater feeds than possible with steels of corresponding analyses. Available in following types: Freecut (SAE X-1112), Bessemer steels and SAE 1115, X-1315, X-1335, X-1015, 1015, 1035 and 1045 open hearth steels.

1 2 3 - - 6 - 8 -

UNILOY — Universal-Cyclops Steel Corp., Titusville, Pa.

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1435 (stainless grade A), (Type No. 420); chrome 13.50, nickel .50 max., carbon over .12.

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1860 (stainless grade B), (Type No. 440); chromium 17, nickel .50 max., carbon over .12.

Special (18-8), (Type No. 302); chrome 18, nickel 8, carbon .20 max.; heat resisting up to 1600 degrees Fahr.

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25-12, (Type No. 309); chrome 24, nickel 12; heat resisting up to 1800 degrees Fahr.

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1409, (Type No. 410); stainless iron; chromium 13, carbon .12 max.

1809, (Type No. 430); high chrome stainless iron; chromium 18, carbon .12 max.

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2825, (Type No. 446); high chrome iron; chromium 28, carbon .35 max.; heat resisting to 2000 degrees Fahr.

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UNION—Union Drawn Steel Div., Republic Steel Corp., Massillon, O.

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Freecut; carbon .13 max., manganese .6 to .9, phosphorus .08 to .11, sulphur .1 to .2; a bessemer type steel recommended for high production screw machine parts requiring good finish.

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Supercut; a bessemer type bar steel; manganese .60 to .90, phosphorus .08 to .11, and sulphur .200 to .300; similar to Freecut.

Hymo; carbon .15 to .0, manganese 1 to 1.30, phosphorus .04 max., and sulphur .10 to .18; recommended for spark plug shells, hose brake couplings, piston pins, king pins and carburized gears.

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Special Carburizing; carbon .13 to .18, manganese .60 to .90; phosphorus .04 max., sulphur .05 max., and silicon 15-30; recommended for piston pins and carburized gears.

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UNION METAL—Union Metal Mfg. Co., Canton, O. Seamless steel tubing; medium abrasion resistance; tensile strength 60,000 to 70,000 lbs. per sq. in.; medium ductility; good weldability; used for legs, braces, stands, supports and treadles.

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UNIVAN—Union Steel Casting Co., Pittsburgh. Nickel vanadium alloy; for locomotive frames, crossheads, coupling boxes, driving wheel centers, etc.

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USS—United States Steel Corp. subsidiaries, including Carnegie-Illinois Steel Corp., Columbia Steel Co., National Tube Co., Tennessee Coal, Iron & Railroad Co., and American Steel & Wire Co.

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Type 302, USS 18-8; carbon over .08 to .2, chromium 17.5 to 19 and nickel 8 to 9; atmospheric, acid and heat resistant; has ductility facilitating fabrication.

Type 304, USS 18-8-S; carbon .08 max., chromium 17.5 to 19, and nickel 8 to 9; similar to type 302; used where excellent corrosion resistance is desired after fabrication by welding.

Type 321, USS 18-8-Ti; carbon .1 max., chromium 17 to 20, nickel 7 to 10; titanium minimum 4 x carbon; and alloy of the 18-8 group in which the addition of titanium prevents susceptibility to intergranular corrosion.

Type 316, USS 18-8-S-Mo; carbon .1 max., chromium 16 to 19, nickel 14 max. and molybdenum 2 to 4; an alloy of the 18-8 group, addition of molybdenum increases resistance to corrosion in specific cases.

Type 309, USS 25-12; carbon .2 max., chromium 22 to 26 and nickel 12 to 14; good high temperature strength and toughness combined with resistance to scaling up to 2100 degrees Fahr.

Type 303, USS 18-8 FM; carbon .2 max., chromium 17 to 19, nickel 7 to 9.5, sulphur or selenium .07 min., or molybdenum .6 max.; an 18-8 alloy; addition of sulphur, selenium or molybdenum increases the machinability, generally not to be used where welding is required.

Type 347, USS 18-8 Cb; carbon .1 max., chromium 17 to 20, nickel 8 to 12 and columbium 6 to 10 x carbon; 18-8 alloy, addition of columbium prevents susceptibility to intergranular corrosion.

Type 501, USS 5; carbon over .1 and chromium 4 to 6.

Type 502, USS 5-S; carbon .1 max. and chromium 4 to 6; .5 molybdenum is added to increase creep strength and avoid temper brittleness; columbium is added to eliminate air-hardening and increase oxidation resistance slightly.

Type 410, USS 12; carbon .12 max., chromium 10 to 13.5 corrosion and oxidation resistant, responds to heat treatment and can be modified by the addition of columbium, aluminum and molybdenum for specific applications.

Type 416, USS 12 FM; carbon .12 max., chromium 12 to 14 and sulphur or selenium .07 min. or molybdenum .6 max.; similar to Type 410 except addition of sulphur, selenium or molyb-

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

denum increases the machinability; not to be used where welding is required.

Type 430, USS 17; carbon .12 max. and chromium 14 to 18; resistant to atmospheric and milder chemical corrosives; finds wide usage in nitric acid equipment.

Type 446, USS 27; carbon .35 max. and chromium 23 to 30; resists heat up to 2150 degrees Fahr.; does not have high temperature, strength and toughness of 25-12.

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Shelby 5 per cent chrome molybdenum tubing; used for furnace tubes in oil cracking stills, condensers and superheaters where high temperatures and pressures, and corrosive fluids are handled; chromium .15 max., manganese .50 max., silicon .50 max., carbon 4-6, and molybdenum .45-65.

Shelby tubing may be obtained in many additional grades from the lowest carbon boiler tube steel to the stainless grades of alloy steel which are available in tubing in all sizes up to 10¾ inches outside diameter. A number of steels made to S.A.E. standards are also furnished in Shelby tubing.

Castings furnished by Lorain Div.: Type A-1; carbon .30 to .40, chromium .75 to 1, nickel 2.5 to 3, manganese .60 to .80, and molybdenum .30 to .40; Type A3; carbon .45 to .55, chromium .75 to .90, nickel .60 to .80, manganese 1.5 to 2, and molybdenum .30 to .40; and Type MS-1; carbon 1-14, chromium .75-1, manganese 10-14.

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Electrical steel sheets for use in transformers, motors and generators; Ten principal grades of electrical sheets furnished—USS Pole, Field, Armature, Electrical, Motor, Dynamo, Radio Transformer 72, and Transformer 72, 65 and 58.

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Materials furnished by American Steel & Wire Co., Cleveland, include plates, shapes, rods, bars, sheets, strip steel, wire and wire products, pipe, tubing and tubular products.

See advertisement pages 6D-7D

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WAUKESHA—Waukesha Foundry Co., North Chicago, Ill.; a copper-base alloy with high nickel content which resists mild acids and heat up to 750 degrees Fahr.; tensile strength 650,000 lbs. per sq. in.; for sand cast parts of food handling and dairy machinery, carbonated beverage, brewery and meat packing equipment.

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WEARWELD—Lincoln Electric Co., Cleveland; brinell hardness of 488 to 548; suitable for hard-facing wearing surfaces subject to shocks and abrasion.

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WEBB BLUE LABEL—The Webb Wire Works, New Brunswick, N. J. Music wire for winding into springs; carbon .80 to .90; phosphorus and sulphur below .025; high ductility; for springs.

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WEBB ORANGE LABEL "SHIP BRAND"—The Webb Wire Works, New Brunswick, N. J. Stainless spring wire; resists corrosion; chrome 18, nickel 8, carbon less than .08; heat resistant to 700 degrees Fahr.; used in springs.

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WELLCAST 17 S—The Wellman Bronze & Aluminum Co., Cleveland. High-strength, aluminum - silicon - titanium alloy with high ductility; used in aircraft castings; tensile strength, 28,000 to 30,000 lbs. per sq. in.

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WILRICH—Wilcox-Rich Div., Eaton Mfg. Co., Detroit.

Type 600; abrasion and corrosion resistant alloy; available as centrifugal castings, blanks or finished parts; resists corrosion due to alloy content; heat resistant up to 1000 degrees Fahr.; high abrasion resistance; tensile strength 46,000 lbs. per sq. in.; compressive strength 240,000; ductility low; specific gravity 8.33; good bearing properties; brinell hardness, as cast, 627 to 780; used for rolls, dies, sleeves, seals, bushings, collets, etc.

Type 625; corrosion and abrasion resistant alloy; available as centrifugal castings, blanks and finished parts; resists heat up to 1800 degrees Fahr.; medium ductility; specific gravity 7.68; good bearing properties; brinell hardness, as cast, 600; for rolls, dies, sleeves, seals, bushings, collets, etc.

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WILSON CONTACT MATERIALS, Electrical—The H. A. Wilson Co., Newark, N. J. Silver, platinum, tungsten and alloy contacts; silver-steel laminated contacts for projection welding; silver composite contacts; silver and platinum inlay and overlay on base metals. Furnished in sheet and wire.

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WOLVERINE—Wolverine Tube Co., Detroit.

Aluminum brass; copper 76, zinc 22, and aluminum 2; furnished in tubing; corrosion resistant due to salt water and marine land stations; medium abrasion resistance; tensile strength 52,000 to 90,000 lbs. per sq. in.; medium ductility; good bearing properties; for bushings, condenser tubing.

Admiralty brass; copper 70, zinc 29 and tin 1; furnished in tubing; medium abrasion resistance; tensile strength 50,000 to 95,000 lbs. per sq. in.; medium ductility; specific gravity 8.54; weldability fair; for condenser tubing.

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70-30 brass; copper 70, and zinc 30; furnished in tubing; resists corrosion due to steam condenser tubing; medium abrasion resistance; tensile strength 45,000 to 70,000 lbs. per sq. in.; medium ductility; specific gravity 8.53; weldability fair; used for condenser tubing.

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Red brass; copper 85 and zinc 15; furnished in tubing; resists corrosion caused by salt water, mild acids and water supply; medium abrasion resistance; tensile strength 42,000 to 75,000 lbs per sq. in.; ductility high; specific gravity 8.73; weldability fair; for condenser tubing.

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Common high brass; copper 66, lead .8 max. and zinc balance; furnished in tubing; resists corrosion due to water supply; medium abrasion resistance; tensile strength 45,000 to 90,000 lbs. per sq. in.; medium ductility; specific gravity 8.47; weldability fair; bearing properties fair; for cupped, formed or drawn parts, etc.

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Copper, Oxygen-free; copper and silver 99.9 min., phosphorus .015-.035 (optional as deoxidizer); furnished in tubing; resists corrosion caused by atmospheric and acid solutions of low oxidizing capacity and hot reducing gases; tensile strength 32,000 to 60,000 lbs. per sq. in.; high ductility; specific gravity 8.93; good weldability; for condensers, evaporators, heaters and condenser tubes, sugar mills, refrigeration, etc.

Copper-Arsenical; copper and silver 99.2 min., phosphorus .015 to .035, and arsenic .15 to .75; furnished in tubing; resists corrosion caused by atmospheric and acid solutions of low oxidizing capacity and hot reducing gases; tensile strength 32,000 to 60,000 lbs. per sq. in.; ductility high; specific gravity 8.93; weldability good; for condensers, evaporators, heater and condenser tubes, sugar mills, refrigeration, etc.

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WORTHITE—Worthington Pump & Machinery Corp., Harrison, N. J. Iron .48, nickel 24, chromium 20, molybdenum 3, carbon .07 max., and other elements 5; a sand casting alloy; furnished in rods and bars; resists sulphuric, nitric, phosphoric, acetic, weak muriatic acids and all caustics and alkalies; also resists heat up to 1900 degrees Fahr.; tensile strength 67,000 to 75,000 lbs. per sq. in.; brinell hardness 125 to 150 (cast); for valves, bolts, pump casings and impellers, propellers, agitators, shafts, piston rods, fittings, etc.

X, Y, Z

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XALOY—Wilcox-Rich Div., Eaton Mfg. Co., Detroit. Carbon 3.25, boron, 1, silicon .75, nickel 4; available as centrifugal castings, blanks or finished parts; resists heat up to 800 degrees Fahr.; high abrasion resistance; tensile strength 30,000 to 45,000 lbs. per sq. in.; compressive strength 225,000; ductility low; specific gravity 7.58; good bearing properties, high magnetic properties; brinell hardness, as cast, 700 to 750; used for rolls, dies, sleeves, seals, bushings, collets, etc.

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X-ITE—General Alloys Co., Boston, Nickel 37 to 40, chromium 17 to 21; for furnace parts not subjected to alternate heating and cooling cycles; standard material for commercial heat treating furnace parts.

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X-7—General Alloys Co., Boston. Chrome 23 to 28, nickel 10 to 13; tensile strength 80,000 lbs. per sq. in.; recommended for castings subject to temperatures up to 2000 degrees Fahr.

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YOLOY—Youngstown Sheet & Tube Co., Youngstown, O. Special service alloy steel of increased tensile strength and high ductility combined with corrosion resistance.

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ZAMAK—New Jersey Zinc Co., New York. Zinc alloys for die cast machine parts.

No. 2; aluminum 4.1, copper 2.7, magnesium .03, remainder Horse Head special zinc.

No. 3; aluminum 4.1, magnesium .04, remainder Horse Head special zinc.

No. 5; aluminum 4.1, copper 1, magnesium .03, remainder Horse Head special zinc.

See advertisement page 68D

1 2 - - 5 - - - - -

ZINCGRIP—American Rolling Mill Co., Middletown, O. Galvanized sheet iron or steel, in strips or coils, with unusual forming and drawing qualities; for use wherever severe forming necessarily makes ordinary galvanized sheet metal unsatisfactory.

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Z-METAL—Produced under metallurgical control of the Castings Corp., Buffalo, by foundries equipped with special heat treatment equipment. Alloyed white iron having high physical characteristics; high ultimate strength and yield point, adequate ductility. Licensees include: Chain Belt Co., Milwaukee and Arcade Malleable Iron Co., Worcester, Mass.

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ZORITE—Michiana Products Corp., Michigan City, Ind. Nickel 37, chromium 15 per cent.

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

Plastics and other Nonmetallics Listed by Tradenames

(For listing by producing companies, and complete street addresses, see Page 46 D)

A

1 - - - - - 7 - - 10
ACE—American Hard Rubber Co., New York. Hard rubber materials; furnished in sheet form or rods and tubes; machined, molded and stamped into part. Besides resistance to corrosion, low moisture absorption and high polish, material has tensile strength (4000-9000 lbs. per sq. in.), heat resistance (150-190 degrees Fahr.), dielectric strength (250-290 volts per mil.) and nonflammability. Uses include handles, caster wheels and special molded parts.

1 2 - - - 6 - - - -
AERTITE—Johns-Manville, New York. Rubbery, asphaltic-asbestos material; furnished in soft plastic form. Principal properties are resistance to corrosion, head resistance and nonflammability. Used on mechanical equipment to prevent air infiltration.

1 - - 4 5 - - - - -
AETNA—Aetna Rubber Co., Cleveland. Hard rubber material; furnished in rods and sheets. Principal properties are corrosion resistance, comparatively high tensile strength and dielectric strength. Material is unusually low in specific gravity. Used for storage battery containers, vent caps, covers and nuts.

1 - 3 4 - - - - - -
AIRVULC—Self-Vulcanizing Rubber Co. Inc., Chicago. Gum rubber base material; furnished in liquid form. Be sides abrasion resistance, corrosion resistance and comparatively high tensile strength (2000 lbs. per sq. in.), material has resistance to shock, high polish, flexibility, heat resistance (212 degrees Fahr.), low moisture absorption and availability in colors. Used in machines to resist corrosion or abrasion as a sound deadener and for insulation and waterproofing.

1 - - - 5 - - - 9 -
AJAX—Vulcanized Rubber Co., New York, Hard rubber, thermoplastic material; furnished in sheet form or rods and tubes; molded, machined, stamped, and extruded into parts. Three principal properties are dielectric strength (6500 volts per mil), corrosion resistance and availability in colors. Others include abrasion resistance, high polish, flexibility, tensile strength (6500-9000 lbs. per sq. in.) and resistance to shock. Soluble only in carbon disulphide. Used for handles, bushings, strips, rod and tube bases.

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AMEROID—American Plastics Corp., New York. Casein base, thermoplastic material; furnished in sheet or rod form, for machining into part. Besides nonflammability, high polish and availability in colors, material has resistance to corrosion, tensile strength (7600 lbs. per sq. in.), heat resistance (150 degrees Fahr.), translucence and dielectric strength (290 volts per mil.). Uses include small knobs, bushings, washers and similar parts.

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AMPHENOL—American Phenolic Corp., Chicago. Phenolic base; thermoplastic material; furnished in rods or tubes. Material has high dielectric and compressive strengths, low moisture absorption, availability in colors, translucence, nonflammability, high polish and corrosion resistance. Uses include electrical sockets, plugs and the housings of current-carrying parts.

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ARCOLITE—Consolidated Molded Products Corp., Scranton, Pa. Phenol-formaldehyde base, thermosetting material; furnished in powder, for molding into parts. May be molded around or over metal or wood cores in parts requiring great strength and rigidity. Besides dielectric strength (325 volts per mil), heat resistance (300-400 degrees Fahr.) and tensile strength (7000-12,000 lbs. per sq. in.), material has high polish, nonflammability, availability in colors and low moisture absorption. Used for parts and decorative items on machines.

B

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BAKELITE—Bakelite Corp., New York.

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Cellulose filled—Phenolic base; thermosetting material; furnished in powder form; molded into part. Besides corrosion resistance, high dielectric strength (300-500 volts per mil) and nonflammability, material has tensile strength (6000-11,000 lbs. per sq. in.); low thermal conductivity; availability in colors, and low moisture absorption. Used for knobs, handles and electric insulating parts.

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Mineral filled—Similar material to above but has higher heat resistance and lower moisture absorption than cellulose-filled material.

1 - 3 - 5 - - - - -
Fabric filled—Similar material to cellulose Bakelite but contains chopped fabric giving high impact resistance, as well as abrasion resistance and high dielectric strength (300-400 volts per mil). Used for gears, bushings, bearings and lever handles or parts requiring resistance to shock.

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Laminated materials — Furnished in laminated sheets, tubes and rods; machined into part. Principal properties are resistance to shock, high dielectric strength and low oil absorption. Translucent in some forms; tensile strength (8500-24,000 lbs. per sq. in.), and flexible in sheet forms. Used for gears, bushings, etc., and parts requiring shock resistance and no oil absorption.

- - - - - - - 7 8 9 -
Cast resinol C-1 and C-25—Furnished in sheets, tubes, rods and special forms; cast and machined into parts. Principal properties are translucence, high polish, and availability in colors. Other properties similar to mineral and cellulose-filled materials. Used for decorative fittings and for transparent gages and instruments or parts requiring resistance to hydrofluoric acid.

1 2 - - - - - - - - -
BALSA—International Balsa Corp., Jersey City, N. J. A lightweight wood used where strength, insulation, isolation, buoyancy, etc., are desired—the automotive, aircraft, household, industrial, marine, etc., machinery, and in coolers, permanent wave machines, office machines, etc.

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BEETLE—Beetleware Division, American Cyanamid Co., New York. Urea formaldehyde base, thermosetting material; furnished in resin for laminating; molded into parts. Besides availability in colors, resistance to shock and translucence, material has high polish, dielectric strength (280 volts per mil), tensile strength (5500-7000 lbs. per sq. in.) and nonflammability. Used for housings, cabinets, knobs, dials, panels and insulators. Material is available with slightly different properties for specific applications.

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BOOTH FELT—Booth Felt Co. Inc., Brooklyn, N. Y. Wool base felt; furnished in sheets or strips; machined and stamped into parts. Principal prop-

1—Corrosion resistance; 2—High heat resistance; 3—Impact resistance; 4—High tensile strength; 5—High dielectric strength; 6—Nonflammable; 7—Takes high polish; 8—Translucence; 9—Available in colors; 10—Low moisture absorption

erties are heat resistance (400 degrees Fahr.), high tensile strength for type of material (5 to 100 lbs. per sq. in.) and availability in colors. Available in a variety of types and grades for uses such as washers, gaskets, grease seals, and pads for insulating machinery or reducing vibration.

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BRANDYWINE FIBRE—Brandywine Fibre Products Co., Wilmington, Del. Paper chemically treated to form a solid homogeneous mass; furnished in tubes for winding. Material has dielectric strength, (250 volts per mil) tensile strength, (5000-8500 lbs. per sq. in.), heat resistance (150-200 degrees Fahr.), availability in colors, impact resistance and specific gravity of 1.20 to 1.45. Used for spacers, ferrules, washers, handles, bearings and noiseless bumpers.

C

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CATALIN—Catalin Corp., New York. Phenolic base, thermosetting material; furnished in sheets, rods, or special castings. Besides dielectric strength, nonflammability and low moisture absorption, material has high tensile and compressive strengths, availability in colors, and insolubility in ordinary solvents. Used for clock and instrument cases, auto fittings, knobs for electrical appliances, etc.

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CELLANITE—Continental-Diamond Fibre Co., Newark, Del. Resinous base, thermosetting material; furnished in laminated form, for machining into parts. Besides corrosion resistance, heat resistance, and low moisture absorption, material has high dielectric strength, tensile strength, and thermal insulating properties. Odor repellant. Used for frost breaker strips on refrigerator cabinets and many other applications.

1 2 - - - 6 - - - -

CELITE—Johns-Manville, New York. Diatomaceous silica material; furnished in powdered, granular and brick forms. Principal properties are resistance to chemical corrosion, heat resistance and nonflammability. Used for insulation of equipment operating at high temperatures.

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CELLULOID—Celluloid Corp., Newark, N. J. Cellulose nitrate base, thermoplastic material; furnished in sheet form or rods and tubes, for molding, swedging, veneering, machining or stamping into parts. Available in colors; high polish and tensile strength (5000-10,000 lbs. per sq. in.) material has flexibility, resistance to corrosion, dielectric strength (600-1200 volts per mil) and transparence. Used for instrument dials, tool handles, key buttons, register wheels, etc.

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CEL-O-GLASS—E. I. du Pont de Nemours & Co., Wilmington, Del. Plastic coated wire mesh which transmits ultraviolet rays. Besides corrosion resistance and resistance to shock, the material is translucent, flexible and very light in weight. Used for sign boards, display backgrounds or any place where a translucent, flexible material is required.

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CELORON — Continental-Diamond Fibre Co., Newark, Del. Resinous base, thermosetting material; furnished in molded laminated form; for machining into parts. Besides corrosion resistance, resistance to shock and tensile strength, material has low moisture absorption, high heat resistance and abrasion resistance. Grade C (canvas base) used for heavy duty gears. Type L (linen base) used for small gears of fine pitch and narrow face.

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CODITE—Continental-Diamond Fibre Co., Newark, Del. Vulcanized fibre, thermoplastic material; furnished in molded sheets, rods and tubes, for machining into parts. Besides tensile strength, dielectric strength and translucence, material has flexibility and high polish. Used for washers and parts requiring a hard, tough, flexible material.

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COLASTA No. 56—Specialty Insulation Mfg. Co. Inc., Hoosick Falls, N. Y. Resinous material compounded with small percentage of rubber. Principal properties are corrosion resistance, dielectric strength and low moisture absorption. Developed for aircraft magneto applications; highly resistant to carbon tracking; impervious to oil and weak acids.

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CORINCO—Cork Insulation Co. Inc., New York. Cork material; furnished in boards and panels. Principal properties are corrosion resistance, heat resistance and low moisture absorption. Material is nonflammable and has high dielectric strength. Used for noise and vibration dampening in machines. Available in proper densities to withstand machinery loads.

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CORPRENE—Armstrong Cork Products Co., Lancaster, Pa. Cork and synthetic rubber compound; cold molded into parts. Besides corrosion resistance, comparatively high heat resistance and low moisture absorption, material has surface giving high coefficient of friction, extreme resistance to oil, oxidation, corona and weather. Used for sealing on gaskets, valve disks and valve packings, etc.

1 - 3 - - - - 8 - -

CRYSTALLITE—Rohm & Haas Co. Inc., Philadelphia. Acrylic base, thermoplastic material; furnished in molding powder for compression and injection. Besides corrosion resistance, resistance to shock and translucence, the material has flexibility, low specific gravity (1.18), and tensile strength (4000-6000 lbs. per sq. in.).

D

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DIAMOND — Continental-Diamond Fibre Co., Newark, Del. Vulcanized fibre, bone-like material; furnished in sheets, rods and tubes, for machining, sawing or punching into parts. Besides tensile and dielectric strength and low specific gravity, material is tough, pliable and easily machined into parts. Used for insulating members, gears, bobbin heads, etc.

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DILECTO — Continental-Diamond Fibre Co., Newark, Del. Phenolic base, thermosetting material; furnished in laminated sheets, rods and tubes, for machining and stamping into parts. Besides dielectric strength (270-500 volts per mil), low moisture absorption and tensile strength (10,000 to 25,000 lbs. per sq. in.), material has resistance to corrosion, heat resistance (290 degrees Fahr.), availability in colors, resistance to shock and insolubility. Used for electrical, thermal and mechanical insulating parts.

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DILOPHANE—Continental-Diamond Fibre Co., Newark, Del. Resinous base, thermosetting material; furnished in laminated sheet form, for machining, stamping and forming into parts. Besides availability in colors, translucence and nonflammability, material has dielectric strength (450-600 volts per mil), tensile strength (12,000-13,000 lbs. per sq. in.), resistance to impact, heat resistance (275 degrees Fahr.), flexibility, and high polish. Used for radio and clock dials, insulating parts where color and appearance are important.

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DUFELT—Felters Co. Inc., Boston, Mass. Felt in form of laminated washers for oil and grease retainment. Principal properties are corrosion resistance, dielectric strength and low moisture absorption. Company produces other forms and shapes to provide resiliency, isolate sound, absorb vibration and shock and to insulate from heat or cold. Other uses include covers for polishing rolls, wicks for lubrication of bearings, dustproofing and filtering.

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DUPRENE—See under Neoprene.

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DUREZ—General Plastics Inc., North Tonawanda, N. Y. Phenolic base, thermosetting material; furnished in powder form, for molding into parts. Besides resistance to corrosion, high polish (comes from mold with lustrous finish), and low moisture absorption, material has heat resistance (350-450 degrees Fahr.), tensile strength (4000-6000 lbs. per sq. in.), availability in colors, resistance to shock, and abrasion resistance. Used for housings, handles, bases, electrical parts, small gears, frames, hoods, etc.

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DURITE—Durite Plastics Inc., Frankford Sta., P. O., Philadelphia. Phenol-furfural and phenol-formaldehyde synthetic resinous, heat-setting material; available in crushed, pulverized or liquid form for bonding hot or cold molding compound, plywood, veneer, cements, abrasive articles, etc., or in powder form for hot press molding. Material possesses high heat and shock resistance, and tensile and dielectric strengths. Used for cabinets, housings, handles, keys, knobs, automotive ignition, etc.

E

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EBROK—The Richardson Co., Melrose Park, Ill. Acid resisting bituminous plastic material for specific requirements including such parts as battery containers.

See advertisement page 63D

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EEL-SLIP — Johns-Manville, New York. Asbestos, fiber, graphite and rubber compound. Principal properties are heat resistance, tensile strength and nonflammability. Used for bearings, suction box covers, etc.

1—Corrosion resistance; 2—High heat resistance; 3—Impact resistance; 4—High tensile strength; 5—High dielectric strength; 6—Nonflammable; 7—Takes high polish; 8—Translucence; 9—Available in colors; 10—Low moisture absorption

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EMPIRE—Mica Insulator Co., New York. A varnished cambric cloth for electrical insulation of cables, bus bars, coils, joints and splice work, etc. Meets all requirements as to dielectric strength, tensile strength, elongation, pliability, finish, uniformity and resistance to aging.

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ETHOFOIL—The Dow Chemical Co., Midland, Mich. Ethyl cellulose base thermoplastic material; furnished in sheet form and can be laminated, heat-formed or cemented. Material has corrosion resistance, flexibility, dielectric strength (3500 volts per mil on .001-inch thickness), tensile strength (10,000 lbs. per sq. in.), heat resistance (300 degrees Fahr.), low moisture absorption, availability in colors, and specific gravity of 1.14. Used for insulating foil.

See advertisement page 5D

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ETHOCEL—The Dow Chemical Co., Midland, Mich. Plastic granules, thermoplastic material; furnished in powder form for molding into parts. Material has dielectric strength (1500 volts per mil on 0.10-in. thickness), tensile strength (7000-8500 lbs. per sq. in.), heat resistance (130-150 degrees Fahr.), low moisture absorption, availability in color, specific gravity of 1.10 to 1.25, translucence, opaqueness, and compressive strength (10,000-12,000 lbs. per sq. in.). Used for knobs and insulation.

See advertisement page 5D

F

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FARLITE—Farley & Loetscher Mfg. Co., Dubuque, Iowa. Phenolic and urea base, thermosetting material; furnished in laminated sheet form, for machining and stamping into parts. Besides resistance to corrosion, high polish and low moisture absorption, material has impact resistance, translucence, availability in colors, tensile strength (6000-8000 lbs. per sq. in.), and dielectric strength (200-400 volts per mil). Used for sawed or stamped flat parts for light machine members.

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FARLITE LOETEX—Farley & Loetscher Mfg. Co., Dubuque, Iowa. Fibrous synthetic core with laminated Bakelite surface, thermosetting material; furnished in sheets, for machining into parts. Besides dielectric strength (250 volts per mil), resistance to corrosion and high polish, material has resistance to impact, low moisture absorption, tensile strength (5000-6000 lbs. per sq. in.), and heat resistance (250 degrees Fahr.). Used for low voltage insulation with moderate strength.

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FELTERS CERTIFIED FELT—Felters Co. Inc., Boston. Felt cut to size for grease and oil retention; for lubricators, bumpers, antisqueak and rattle parts, and filters.

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FIBERLOID—Monsanto Chemical Co., Plastics Div., Indian Orchard, Mass. Cellulose nitrate base, thermoplastic material; furnished in sheets, rods and tubes, or in laminated form, for machining, molding, stamping, swedging or blowing (steam) into parts. Besides resistance to corrosion, translucence, and availability in colors, material has flexibility, dielectric strength (750-900 volts per mil), tensile strength (6000-9000 lbs. per sq. in.), and low moisture absorption. Used for sight glasses, safety glass, oilproof insulation, dial covers, knobs, handles and structural models for strain study.

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FIBERLON—Monsanto Chemical Co., Plastics Div., Indian Orchard, Mass. Phenolic base, thermosetting material; furnished in sheets, rods and tubes, or laminated form; cast and machined into parts. Besides translucence, dielectric strength (250-700 volts per mil), and corrosion resistance, material has tensile strength (6000-11,000 lbs. per sq. in.), high polish, low moisture absorption (0.05-0.07 per cent), and availability in colors. Used for safety shields, electrically insulated knobs and handles and structural models for strain study.

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FIBESTOS—Monsanto Chemical Co., Plastics Div., Indian Orchard, Mass. Cellulose nitrate base, thermoplastic material; furnished in sheet, laminated and powder forms or rods and tubes, for molding, machining, stamping or swedging into parts. Besides resistance to corrosion, transparence and availability in colors, material has flexibility, high polish, dielectric strength (540-1800 volts per mil) and tensile strength (6000-6800 lbs. per sq. in.). Used for safety glass, compressible shims, couplings, gaskets, electrically insulated knobs and handles.

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FORMICA—Formica Insulation Co., Cincinnati. Resinous base, thermosetting material; furnished in laminated form; machined or stamped into parts. Principal properties are corrosion resistance, tensile strength (slightly less than cast iron), and dielectric strength. Absorbs no oil and changes in dimensions only slightly as the result of moisture absorption. Material has good insulating qualities. Used for insulating washers and bushings, punched parts in switches, automotive starting systems and for all types of heavy duty gears.

See advertisement page 57D

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FYBEROID—Wilmington Fibre Specialty Co., Wilmington, Del. Paper base material; furnished in sheet form, for machining or stamping into parts. Besides dielectric strength (200-400 volts per mil), tensile strength (5000-8000 lbs. per sq. in.) and flexibility, material has abrasion and corrosion resistance. Used for insulation on motors, generators, automotive ignition starters, etc.

G

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GEMLOID (Enameloid Cloisonnete)—Gemloid Corp., New York. Cellulose, acetate and nitrate base, thermoplastic material; furnished in laminated sheet form for molding or stamping into parts. Takes high polish, has flexibility and nonflammability, available in color and is translucent. Used for decorative dials for radios, clocks, instrument panels and horn buttons.

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GUMMON—Garfield Mfg. Co., Garfield, N. J. Black, thermosetting material. Besides corrosion and heat resistance (400 degrees Fahr.) and high dielectric strength, material has high polish, and resistance to hot oil. Will not shrink, crack, warp or deteriorate with age. Used for insulated parts such as wiring devices and other small units.

H

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HARVITE—Siemon Co., Bridgeport, Conn. Shellac base thermosetting material; molded into parts. Besides corrosion resistance, low moisture absorption and availability in colors, material has comparatively high heat resistance (175 degrees Fahr.) and dielectric strength. Used for insulated switch handles and as electric insulator.

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HASKELITE—Haskelite Mfg. Corp., Chicago. Waterproof plywood having light weight, with strength, elasticity and hardness; bendable into desired forms and shapes. Used for airplanes, buses, street cars, railways, radio cabinets and speakers, passenger cars, etc.

1 2 3 . . . . . .

HAVEG—Haveg Corp., Newark, Del. Phenolic base, thermosetting material; furnished in finished form; molded and machined into parts. Besides corrosion resistance, heat resistance (275 degrees Fahr.) and resistance to shock, material has abrasion resistance, tensile strength (5600 lbs. per sq. in.), low moisture absorption and nonflammability. Used for chemical equipment and parts where chemical resistance is an important factor.

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HAVEGIT—Haveg Corp., Newark, Del. Phenol formaldehyde base, thermosetting cement. Principal properties are corrosion resistance (acids), heat resistance and low moisture absorption. Properties similar to Haveg. Used in setting up brick and tile linings in chemical equipment.

1 2 10

HEMIT—Garfield Mfg. Co., Garfield, N. Y. Gray-white material. Principal properties are corrosion resistance, heat resistance (1100-1500 degrees Fahr.), and low moisture absorption. Used for interior parts of heating devices, such as arc shields or where a molded part must withstand an arc. Specially impregnated for moisture resistance.

I

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INDUR—Reilly Tar & Chemical Corp., Indianapolis. Phenolic base, thermosetting material; furnished in powder form, for molding into parts. Besides tensile strength (7200 lbs. per sq. in.), dielectric strength and nonflammability, material has corrosion resistance, availability in colors and low specific gravity (1.2-1.9). Used for instruments and machine accessories including insulating panels, knobs and handles.

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INDUR VARNISH—Reilly Tar & Chemical Corp., Indianapolis. Phenolic base, thermosetting material; furnished in liquid form, for molding into parts. Principal properties are dielectric strength, tensile strength, and nonflammability.

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INSULKOTE—Johns-Manville, New York. Weatherproof coating for use over insulation of ducts and other exposed equipment. Principal properties are corrosion resistance, heat resistance and low moisture absorption.

1—Corrosion resistance; 2—High heat resistance; 3—Impact resistance; 4—High tensile strength; 5—High dielectric strength; 6—Nonflammable; 7—Takes high polish; 8—Translucence; 9—Available in colors; 10—Low moisture absorption

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INSUROK—The Richardson Co., Melrose Park, Ill.

Thermosetting material; furnished in laminated sheets, rods and tubes for machining into parts, or as finished molded parts. Properties include corrosion resistance, low moisture absorption, tensile strength, resistance to shock and comparatively low specific gravity. Used for gears, bearings, electrical insulation and parts requiring impact and corrosion resistance. Material available in different grades for various applications.

Translucent type; urea or phenolic base thermosetting material; furnished in molded and laminated sheets for use in signs, displays, rear illumination and changeable background signs. Material is translucent, nonflammable, and has low moisture absorption.

K

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KASOLOID—Synthetic Plastics Co., Newark, N. J. Casein base, thermoplastic material. Principal properties are corrosion resistance, high polish and availability in colors. Material is slightly hydroscopic, therefore unfit for parts where accurate dimensions are important. Used especially for small objects where brilliant color and high luster are desired. Natural color is blond.

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"K" FELT—American Felt Co., New York. Kapok fiber 45, cotton 30 and wool 25; furnished in rolls approximately 24 yards long and 72 inches wide, in thicknesses from ⅛ inch to 1 inches in ⅛ inch steps; produced in white or silver gray. Material is flameproofed and mothproofed; has low moisture absorption. Used for insulating material. Also available in S. A. E. felt specifications.

See advertisement page 65D

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KNIGHT-WARE — Maurice A. Knight, Akron, O. Acid-proof chemical stoneware obtainable in a wide variety of special shapes and sizes. Inert to corrosion of all chemical solutions or gases except hydrofluoric acid and caustic soda, very hard and an excellent dielectric substance, resistant to heat but not sudden heat changes. Used for valves, pipes, jars, tanks, filters, towers, etc.

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KOMPO-KORK—Korfund Co. Inc., Long Island City, N. Y. Plates of finely granulated compressed cork with an oxidized linseed oil binder and burlap backing. Principal properties are corrosion resistance, shock resistance and low moisture absorption. Used where irregularly shaped plates are required for isolating light machinery to combat vibration.

1 - 3 - - - - - - - 10

KORFUND—Korfund Co. Inc., Long Island City, N. Y. Resilient mat of pure natural cork, steel bound and oil treated. Principal properties are corrosion resistance, resistance to shock and low moisture absorption. Material is unaffected by water, acids and temperature changes. Used as machine bases to reduce vibration. Another isolator developed by the company is identical in construction, but is bound with asphalt and felt.

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KORK-RUBBER—Korfund Co. Inc., Long Island City, N. Y.—Plates of finely granulated cork and rubber particles compressed together. Used for vibration dampening of light machines. Principal properties are corrosion resistance, shock resistance and low moisture absorption.

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KOROSEAL—B. F. Goodrich Co., Akron, O. Synthetic rubber; furnished in various consistencies from jelly to bone-like hardness. Principal properties are corrosion resistance, resistance to shock and availability in colors. Jelly is used for making molds for plastic casts, but other compounds sold only as finished products. Superior to rubber in flexing, oxidation and penetration of moisture or gases. Does not swell in oil. Available in molded and extruded forms; also applied as coating to paper and fabric.

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LACANITE—Consolidated Molded Products Corp., Scranton, Pa. Shellac base, thermoplastic material; furnished in sheet form, for molding into parts. Besides low moisture absorption, high dielectric strength and corrosion resistance, material has tensile strength (1000-2000 lbs. per sq. in.), nonflammability and availability in colors. Used principally for electrical apparatus on machines.

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LAMICOID — Mica Insulator Co., New York.

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Paper filled, phenolic base, thermosetting material; furnished in sheet and laminated forms or rods and tubes; machined and stamped into parts. Besides tensile strength (7000-8000 lbs. per sq. in.), heat resistance (250 degrees Fahr.) and low moisture absorption (1-6 per cent), material has dielectric strength (500 volts per mil), high polish, nonflammability, and availability in colors. Used for panel boards, gears, thrust washers, valves, bushings, barriers and punchings.

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Fabric filled—Similar material to above but has higher tensile strength (9000-10,000 lbs. per sq. in.) and lower moisture absorption 1½-2½ per cent).

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Micoid—Similar to above materials but is available in black and brown colors. Tensile strength and dielectric strength slightly lower than above materials.

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LAMITEX—Franklin Fibre-Lamitex Corp., Wilmington, Del. Phenolic base, thermosetting material; furnished in laminated sheets, rods or tubes, for machining and stamping into parts. Material has corrosion resistance, high polish, dielectric strength (500 volts per mil), tensile strength (15,000 lbs. per sq. in.), heat resistance (300 degrees Fahr.), low moisture absorption, nonflammability, and compressive strength (35,000 lbs. per sq. in.). Used for electrical insulation.

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LIGNOTITE — Lignotite Co., Chicago. Casein base, thermoplastic material; furnished in powder form for hot molding into parts. Besides corrosion resistance, tensile strength and dielectric strength, material has heat resistance and low moisture absorption.

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LUCITE—E. I. du Pont de Nemours & Co. Inc., Wilmington, Del. Polymethylmethacrylate base, thermoplastic material; furnished in powder form or in sheets, rods and tubes, for molding, casting and machining into parts. Besides translucence, availability in colors, resistance to shock and low moisture absorption, material has high polish, resistance to corrosion, tensile strength (8000-10,000 lbs. per sq. in.) and heat resistance (180-230 degrees Fahr.). Used for panels, knobs, models, safety guards, dials and gage glasses.

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LUMARITH—Celluloid Corp., Newark, N. J. Cellulose acetate base, thermoplastic material; furnished in sheets, powder or rods and tubes. Besides availability in colors, tensile strength (4500-11,000 lbs. per sq. in.), and dielectric strength (500-2500 volts per mil), material has high polish, flexibility, resistance to shock and corrosion. Used for instrument dials and housings, radio grills, panels, airplane windshields, handles, knobs, register wheels, key buttons, electrical insulated parts, etc.

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LUZERNE HARD RUBBER—The Luzerne Rubber Co., Trenton, N. J. Hard rubber, thermoplastic material; furnished in sheets, rods or tubes, for molding and machining into parts. Takes high polish, corrosion resistant to acids and alkalies, dielectric strength or volume resistivity (6×10^7 megohms constant at 22.8 degrees centigrade), tensile strength (3500-9000 lbs. per sq. in.), heat resistant to 120 degrees Fahr., available in some colors, specific gravity of 1.24 average, compressive strength (8000-12,000 lbs. per sq. in.). Used for molded machine parts.

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MAKALOT—Makalot Corp., Boston. Synthetic resinous base; furnished in powder form and also as varnish and cement, for molding into parts. Besides tensile strength, dielectric strength and low moisture absorption, material has heat resistance, abrasion resistance and nonflammability. Flowing and covering characteristics of material eliminate sticking troubles. Used where high strength and shock resistance are important.

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MARBLETTE—Marblette Corp., Long Island City, N. Y. Cast phenolic resin furnished in sheets, rods, tubes and special castings to be fabricated into finished form. All colors; opaque and translucent, mottled or plain; also "Crystle" (water-clear transparent), nonflammable, insoluble, infusible, noncorrosive, odorless, high tensile and dielectric strengths, takes a high polish, and can be easily turned, drilled, sawed, threaded and carved.

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MICABOND—Continental-Diamond Fibre Co., Newark, Del. Fibrous, flexible material; furnished in sheets and tubing, for machining and forming into parts. Principal properties are heat resistance, dielectric strength and low moisture absorption. Used for V-rings, washers, segments and various special shapes.

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MICANITE—Mica Insulator Co., New York. A hard, semirigid sheet of built-up mica, which retains the heat

1—Corrosion resistance; 2—High heat resistance; 3—Imp act resistance; 4—High tensile strength; 5—High dielectric strength; 6—Nonflammable; 7—Takes high polish; 8—Trans lucence; 9—Available in colors; 10—Low moisture absorption

resistant and high dielectric properties of mica. Material is readily machined, punched or molded for such parts as commutator rings, segments, tubes, spools, etc.; also as paper or cloth base tape and flexible plate for cold molding.

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MICARTA—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Phenolic base, thermosetting material; furnished in sheet and laminated form or rods and tubes, for machining or punching into parts. Besides dielectric strength (150-180 volts per mil), low moisture absorption (0.5-5 per cent in 24 hrs.) and resistance to shock, material has corrosion resistance, high polish, flexibility, tensile strength (7000-15,000 lbs. per sq. in.) and availability in colors. Used for bearings, gears, thermal and electrical insulation and parts exposed to acids, alkalies and common solvents.

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MONSANTO — Monsanto Chemical Co., Plastics Div., Indian Orchard, Mass.

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CN; cellulose nitrate base, thermoplastic material; furnished in sheets, rods and tubes, or in laminated form, for machining, molding, stamping, swedging or blowing (steam) into parts. Besides resistance to corrosion, translucence, and availability in colors, material has flexibility, dielectric strength (750-900 volts per mil), tensile strength (6000-9000 lbs. per sq. in.) and low moisture absorption. Used for sight glasses, safety glass, oilproof insulation, dial covers, knobs, handles and structural models for strain study.

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CP; phenolic base, thermosetting material; furnished in sheets, rods and tubes, or laminated form; cast and machined into parts. Besides translucence, dielectric strength (250-700 volts per mil), and corrosion resistance, material has tensile strength (6000-11,000 lbs. per sq. in.), high polish, low moisture absorption (.05-.07 per cent), and availability in colors. Used for safety shields, clock and radio cases, electrically insulated knobs and handles and structural models for strain study.

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CA; Cellulose acetate base, thermoplastic material; furnished in sheet, laminated and powder forms or rods and tubes, for molding, machining, stamping or swedging into parts. Besides resistance to corrosion, transparence and availability in colors, material has flexibility, toughness, high polish, dielectric strength (540-1800 volts per mil) and tensile strength (6000-6800 lbs. per sq. in.). Used for safety glass, and compressible shims, couplings, gaskets, electrically insulated knobs and handles, molded shapes of all descriptions.

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VA; polyvinyl acetal thermoplastic material; furnished in resin, molding powder or sheet form. Extremely tough from freezing temperatures to over 120 degrees Fahr.; sheet has great flexibility and rubberiness. Dielectric strength (800 volts per mil). Used for safety glass, gaskets, adhesives, molded shapes.

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NATIONAL CARBON—National Carbon Co. Inc., Cleveland. Carbon or graphite in amorphous or graphite form; made in a variety of shapes; molded, extruded or machined into parts. In graphitic form carbon possesses excellent lubricating properties. It is highly resistant to most acids, alkalies and solvents. Used for sleeve bearings, packings, threaded parts, nozzles for corrosive liquids, etc.

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NATIONAL FIBRE—National Vulcanized Fibre Co., Wilmington, Del. Converted cotton cellulose, a chemically pure, tough horn-like material; furnished in hard or flexible form in sheets, rolls, tubes, rods and fabricated shapes. Material has high dielectric and mechanical strengths combined with resistance to abrasion and shock, easily formed and machined, light in weight. Used for gears, valve disks, gaskets, washers, bobbin heads, electrical insulation, etc.

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NATIONAL SWITCH INSULATION—National Vulcanized Fibre Co., Wilmington, Del. Combination laminated Bakelite core with vulcanized fiber surfaces; available in sheets and fabricated shapes. Material has high tracking (arc) resistance combined with rigidity and minimum warpage, high dielectric and mechanical strengths, low moisture absorption, and is easily stamped and fabricated. Used in switches to support and insulate current-carrying parts where resistance to tracking and warpage is essential.

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NEILLITE—Watertown Mfg. Co., Watertown, Conn. Phenolic base, thermosetting material; molded into parts. Principal properties are tensile strength, dielectric strength and corrosion resistance. Used for mechanical and electrical purposes.

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NEOPRENE—E. I. du Pont de Nemours & Co. Inc., Wilmington, Del. Chloroprene rubber, formerly sold under the tradename "DuPrene"; available as hose, wire, cable, sheets, tank linings, gaskets, packing, tubing, belting, industrial truck tires and molded goods. Material used as binder for cork and asbestos. Is employed to impregnate or coat canvas, duck or other fabrics. It exhibits the strength, abrasion resistance, resilience and elasticity of rubber. In addition, it has superior resistance to deterioration from contact with oils, greases, gasoline, heat, chemicals, sunlight and ozone. Material is corrosion resistant, will not support combustion, has low moisture absorption, tensile strength (4000 lbs. per sq. in.), and availability in colors. Used for machine applications where rubber characteristics are required but where the product is to be subjected to deteriorating influences.

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NIGRUM—Bound Brook Oil-less Bearings Co., Bound Brook, N. J. Impregnated wood bushings, bearings and washers.

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NIXON—Nixon Nitration Works, East Nixon, N. J.

Molding powder — cellulose acetate, thermoplastic material; for molding into parts. Material takes high polish; has flexibility, dielectric strength (800-850 volts per mil), tensile strength (4500-9500 lbs. per sq. in.), heat resistance to 180 degrees Fahr., low moisture absorption, nonflammability, availability in colors, impact resistance, specific gravity of 1.35 to 1.55, translucence, compressive strength (1200-1600 lbs. per sq. in.), and solubility in ketones and some esters. Used for control knobs and decorations.

Acetate—cellulose acetate thermoplastic material; furnished in laminated sheet, rods and tubes for molding and machining into parts. Material has high polish, flexibility, dielectric strength (1000-2000 volts per mil), tensile strength (7000-11,000 lbs. per sq. in.), low moisture absorption, nonflammability, availability in colors, impact resistance, specific gravity of 1.2 to 1.4, translucence, transparence and opaqueness, compressive strength (5000-11,000 lbs. per sq. in.), and solubility in ketones and some esters. Used for transparent and nonflammable coverings and decorations.

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NIXONOID—Nixon Nitration Works, East Nixon, N. J. Cellulose nitrate base, thermoplastic material; furnished in laminated sheet, rods and tubes for molding, machining and stamping into parts. Material has high polish, flexibility, tensile strength (5000-10,000 lbs. per sq. in.), heat resistance to 145 degrees Fahr., low moisture absorption, availability in colors, impact resistance, specific gravity of 1.35 to 1.46, translucence and opaqueness, and solubility in ketones and esters. Used for transparent covering of exposed parts, and decorations.

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O-I—FIBERGLAS — Owens-Illinois Glass Co., Newark, O. Glass; furnished in mineral wool form. Principal properties are nonflammability, light weight and high insulating value. Others include resistance to corrosion and low moisture absorption. Material is downy white and is placed between walls for insulation purposes. Used in refrigerator cabinets and as filters in air-conditioning equipment.

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OHMOID—Wilmington Fibre Specialty Co., Wilmington, Del.—Phenolic base, thermosetting material; furnished in laminated sheets, rods and tubes, for machining or stamping into parts. Besides dielectric strength (200-700 volts per mil), low moisture absorption (2 per cent) and insolubility in ordinary solvents, material has high polish, corrosion resistance, tensile strength (10,000-14,000 lbs. per sq. in.) and heat resistance (250-300 degrees Fahr.). Used for electric and mechanical insulation.

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PANELYTE—The Panelyte Corp., New York. Synthetic laminated resinous material supplied in sheet, rod, tube and molded form; also fabricated to size. Material has good mechanical strength and marked resistance to acids and alkalies, low moisture absorption and light in weight (specific gravity 1.38). Used for refrigerator breaker strips, radio and electrical insulation, gears, pinions and structural parts; also in decorative grades for table tops, panels, etc.

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PEERLESS—National Vulcanized Fibre Co., Wilmington, Del. Converted cotton cellulose, chemically pure, fish paper insulation; furnished in sheets and rolls. Material has high dielectric strength combined with toughness, springiness and good bending properties. Used extensively for generator and motor insulation and various electrical applications where toughness and forming qualities are essential.

1—*Corrosion resistance;* **2**—*High heat resistance;* **3**—*Impact resistance;* **4**—*High tensile strength;* **5**—*High dielectric strength;* **6**—*Nonflammable;* **7**—*Takes high polish;* **8**—*Translucence;* **9**—*Available in colors;* **10**—*Low moisture absorption*

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PENN—Penn Fibre & Specialty Co., Philadelphia.

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Vulcanized fiber; cotton rag paper base; furnished in sheets, rods or tubes for machining and stamping into parts. Material has tensile strength (12,000-15,000 lbs. per sq. in.), compressive strength (38,000-42,000 lbs per sq. in.), shearing strength (9000-13,000 lbs. per sq. in.), heat resistance (up to 650 degrees Fahr.), dielectric strength (200-400 volts per mil), specific gravity of 1.36 to 1.46, flexibility, insolubility to ordinary solvents, and availability in color. Used for washers, shims, gears, bases, knobs, gaskets and insulating parts.

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Phenol fiber; a phenolic treated paper, canvas and linen; furnished in laminated sheet, rods or tubes for machining and stamping into parts. Specific gravity of paper base 1.36, fabric base 1.38, water absorption of paper base .4 to .8, fabric base .4 to .6 at 24 hours immersion; resistance to heat, paper base 125 degrees Cent., fabric base 110 degrees Cent.; safe limit for constant pressure, paper base 257 degrees Fahr., fabric base 230 degrees Fahr.; tensile strength, ultimate, paper base 14,000 lbs. per sq. in., fabric base 10,000 lbs per sq. in., dielectric strength, volts per mil, paper base 450 and fabric base 225 on ⅛-inch thickness, paper base 700 and fabric base 500 on 1/32-inch thickness; shatterproof. Used for washers, gears, shims, bearings, gaskets, disks, insulation, etc.

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PHENOLITE—National Vulcanized Fibre Co., Wilmington, Del. Laminated Bakelite; furnished with base of paper, cloth or asbestos in sheets, rods, tubes and fabricated shapes; also laminated with rubber sheet. Material has high dielectric and mechanical strengths, low moisture absorption, heat resistance, infusibility, resistance to acids, solvents and oils, high resistance to wear and impact, and excellent machinability. Used in electrical, mechanical and chemical applications for silent gears, bearings, bushings, washers, valve disks, terminal strips, etc.

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PLASTACELE—E. I. du Pont de Nemours & Co. Inc., Wilmington, Del. Cellulose acetate base, thermoplastic materials; furnished in powder, sheets, rods and tubes, for machining and molding into parts. Besides availability in colors, transparence and resistance to shock, material has high polish, corrosion resistance, flexibility, dielectric strength (700-1000 volts per mil), tensile strength (3000-8000 lbs. per sq. in.) and heat resistance (185-250 degrees Fahr.). Used for machine guards, models, control panels, dials, knobs, steering wheels, safety glass screens, etc.

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PLASKON—Plaskon Co. Inc., Toledo, O. Urea formaldehyde base, thermosetting material; furnished in powder form, for molding into parts. Besides translucence, tensile strength (8000-13,000 lbs. per sq. in.), and availability in colors, material has corrosion resistance, high polish, dielectric strength (270 volts per mil), heat resistance (167 degrees Fahr), resistance to shock and low moisture absorption (1-2 per cent). Used for housings, trim, knobs, dials, etc.

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PLEXIGLAS—Rohm & Haas Co. Inc., Philadelphia. Acrylic base, thermoplastic material; furnished in sheets and rods. Besides corrosion resistance, resistance to shock, and translucence, the material has flexibility, low specific gravity (1.18); tensile strength (7000-9000 lbs. per sq. in.); availability in colors and high polish. Used for inspection windows and moldings of all kinds.

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PLYMETAL—Haskelite Mfg. Co., Chicago. Waterproof plywood, sheet metal bonded to one or both faces. Most important physical properties are stiffness, rigidity, lightweight, metal on both faces insuring freedom from warpage. Types of metal available for different purposes are galvannealed steel, stainless steel, aluminum, copper, chrome zinc, chrome steel, porcelain, etc. Used in automotive and aircraft fields.

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POLAROID—The Polaroid Corp., Boston. Light-polarizing glass; furnished in thin, transparent sheets for laminating into finished product. Principal properties are corrosion resistance, nonflammability and transparence. Used for camera filters, polarizing attachments of microscopes, refractometers and other scientific instruments. Material also finds applications in model structures to determine strain, three dimensional motion picture apparatus, glareless auto headlights, etc.

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PRYSTAL—Catalin Corp., New York. Phenolic base, thermosetting material; furnished in sheets, rods or special castings, cast into parts. Besides nonflammability, translucence and low moisture absorption, material has high dielectric strength, corrosion resistance and high refractory index. Material has applications where it is used to replace glass.

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PYRALIN—E. I. du Pont de Nemours & Co. Inc., Wilmington, Del. Nitocellulose base, thermoplastic material; furnished in sheets, rods and tubes; for machining into parts. Besides transparence, availability in colors and resistance to shock, material has corrosion resistance, high polish, flexibility, dielectric strength (300-750 volts per mil) and tensile strength (5000-10,000 lbs. per sq. in.). Used for handles, gage glasses, instrument covers, models, safety glass screens, etc.

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PYREX—Corning Glass Works, Corning, N. Y. Trademark indicating manufacture by above. Heat and chemical resistant. Special technical glass parts supplied under this designation have also high dielectric strength, no moisture absorption and nonflammability.

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PYROFLEX—Maurice A. Knight, Akron, O. Depolymerized colloidal resin base, thermoplastic material; furnished in liquid or sheet form; applied by dipping or cementing sheets to parts. Principal properties are corrosion resistance, dielectric strength and low moisture absorption. Good bonding material where temperatures are not too high.

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PYROPLAX — Cutler-Hammer Inc., Milwaukee. Asbestos base material; furnished in cold-molded pieces. Besides heat resistance (800-1000 degrees Fahr.), nonflammability and dielectric strength (40 volts per mil), material has resistance to corrosion and abrasion resistance. Used for machine parts where high temperature resistance is required.

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RESINOX—Resinox Corp., New York. Phenolic base, thermosetting material; furnished in powder form for molding into parts. Besides heat resistance, low moisture absorption and resistance to shock, material has availability in colors, corrosion resistance, high tensile strength, and high polish. Material is made in a number of molding powders each having slightly different properties. Used for elctrical, mechanical and decorative parts.

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RESOGLAZ—Advance Solvents & Chemical Corp., New York. Molding material may be hot molded and does not cure. Besides resistance to shock, transparence and low moisture absorption, material resists dilute alkalies and acids, but is affected by oils.

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REVOLITE — Atlas Powder Co., Zapan Div., Stamford, Conn. Cloth base impregnated with Bakelite resin; furnished in laminated form. Besides heat resistance and dielectric strength, material has corrosion resistance, low moisture absorption and impact resistance. Used for cable wrappings, endless belts, diaphragms for pumps and valves, gaskets and flexible connections for machinery such as pulverizers where powder is handled.

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ROBERTSON FELT BONDED METAL—H. H. Robertson Co., Pittsburgh, Pa. and Felters Co. Inc., Boston. Felt is bonded to metal by process which makes permanent bond. Felt may be on one or both sides of metal and metal may be bent or twisted without destroying bond. Principal properties are corrosion resistance, tensile strength, nonflammability, availability in colors and low moisture absorption.

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RUB-TEX—The Richardson Co., Indianapolis, Ind. Hard rubber material; molded into parts, particularly desirable for electrical, heat and cold insulation; adapted to many industrial uses.

See advertisement page 63D

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RYERTEX—Joseph T. Ryerson & Son Inc., Chicago. A nonmetallic bearing material designed for use with water lubrication primarily. It has high shock resistance and is suitable for bearing loads up to 5000 lbs. per sq. in.; resistance to acids and mild alkalies.

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SELFVULC—Self-Vulcanizing Rubber Co. Inc., Chicago. Self, cold curing gum rubber; furnished in plastic or liquid form. Besides resistance to corrosion and abrasion, comparatively high tensile strength (2000 lbs. per sq. in.) and resistance to shock, material has flexibility, heat resistance (212 degrees Fahr.), low moisture absorption, and availability in colors. Used in machines to resist corrosion or abrasion, as a sound deadener and for insulation and waterproofing.

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SIRVENE—Chicago Rawhide Mfg. Co., Chicago. Synthetic rubber compounds molded into parts. Resistant to oils and heat, oxidation and weather. Used for sealing oils and greases, packings, gaskets, covers and special parts.

1—*Corrosion resistance;* **2**—*High heat resistance;* **3**—*Impact resistance;* **4**—*High tensile strength;* **5**—*High dielectric strength;* **6**—*Nonflammable;* **7**—*Takes high polish;* **8**—*Translucence;* **9**—*Available in colors;* **10**—*Low moisture absorption*

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SIRVIS—Chicago Rawhide Mfg. Co., Chicago. Special tanned abrasive and heat resisting leather. Used for all types of packings, gaskets and mechanical leather parts.

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SPAULDING ARMITE — Spaulding Fibre Co. Inc., Tonawanda, N. Y. Fibrous material; furnished in sheets and laminated forms for machining, stamping or forming into parts. Besides flexibility, dielectric strength (200-550 volts per mil) and compressive strength (40,000 lbs. per sq. in.), material has abrasion and corrosion resistance, tensile strength (9000-15,000 lbs. per sq. in.), availability in colors and high polish. Used where high dielectric strength, mechanical strength, toughness and forming properties are essential.

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SPAULDING FIBRE—Spaulding Fibre Co. Inc., Tonawanda, N. Y. Fibrous material; furnished in sheet and laminated forms or rods and tubes, for machining, stamping or forming into parts. Besides dielectric strength (150-400 volts per mil), tensile strength (9000-15,000 lbs. per sq. in.) and flexibility, material has abrasion resistance, corrosion resistance, availability in colors and resistance to shock. Used for mechanical applications where toughness, light weight and machining and forming properties are essential.

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SPAULDITE—Spaulding Fibre Co. Inc., Tonawanda, N. Y. Phenolic base, thermosetting material; furnished in sheet and laminated forms for rods and tubes for machining or stamping into parts. Besides dielectric strength (700 volts per mil); low moisture absorption and permanent fine appearance, material has high polish, corrosion resistance, heat resistance (220 degrees Fahr.), and resistance to shock. Used where resistance to moisture and chemicals, fine appearance and permanence are essential.

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SPAULDO — Spaulding Fibre Co. Inc., Tonawanda, N. Y. Fibrous material; furnished in sheet form for machining or stamping into parts. Besides flexibility, dielectric strength (300 volts per mil), and heat resistance (220 degrees Fahr.), material has high polish, corrosion resistance, tensile strength (8000 to 16,000 lbs. per sq. in.) and resistance to shock. Used for applications where flexibility and toughness in both grain directions are essential.

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SPRAYTEX—Monroe Auto Equipment Co., Monroe, Mich. Bituminous base liquid, sprayed on parts for soundproofing housings, covers and other large metal surfaces. Material is corrosion resistant, insoluble in ordinary solvents and heat resistant (250 degrees Fahr.).

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SYNTHANE—Synthane Corp., Oaks, Pa. Laminated Bakelite; furnished in sheets, rods, tubes and fabricated parts. Principal properties are corrosion resistance, tensile strength and dielectric strength. Used for gears, panels, bushings insulation, washers and vibration dampening devices.

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TAYLOR FIBRE—Taylor Fibre Co., Norristown, Pa. Phenolic base, thermosetting material; furnished in laminated sheet, rods or tubes for machining into parts. Material has high polish, flexural strength (12,000-16,000 lbs. per sq. in.), dielectric strength (500 volts per mil), tensile strength (5000-9000 lbs. per sq. in.), heat resistance (300 deg. Fahr.), low moisture absorption, availability in colors, impact resistance, brinell hardness 35 to 45. Used for gears, and insulating and binding material against moderate temperatures.

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TEGIT—Garfield Mfg. Co., Garfield, N. J. Brown or black plastic material. Besides corrosion resistance, high dielectric strength and low moisture absorption, material has heat resistance (300 degrees Fahr.) and high polish. Resists hot oil, boiling water and ordinary chemicals. Will not shrink, crack, warp or deteriorate with age. Used for wiring devices and small insulated parts.

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TENITE—Tennessee Eastman Corp., Kingsport, Tenn. Cellulose acetate base, thermoplastic material; furnished in granular and molding sheets for molding into parts. Besides high polish, availability in colors and resistance to shock, material has flexibility, tensile strength (3500-6200 lbs. per sq. in.), and heat resistance (160 degrees Fahr.). Used for decorative applications.

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TEXTOLITE—General Electric Co., Schenectady, N. Y. Phenolic base, thermosetting material; furnished in sheets, laminated forms, and rods or tubes, molded into parts. Besides resistance to corrosion, tensile strength (5000-20,000 lbs. per sq. in.), and resistance to shock, material has dielectric strength (60-1000 volts per mil), heat resistance (266 to 400 degrees Fahr.), availability in color, translucence in certain grades, and high polish. Used for electrical or thermal insulation, structural parts, gears, cams, bearings, housings, knobs, etc. Material is available in several forms, each having slightly different properties.

See advertisement page ID

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Cold Molded—Two types, nonrefractory material containing asphalt as a binder and asbestos as a filler, and refractory containing cement and drying oils as a binder with an asbestos filler; cold molded at room temperatures and heat treated for strength and toughness. Principal properties are corrosion resistance, and heat and are resistance. Not recommended for parts requiring high dielectric strength or thin sections.

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THERMOPLAX — Cutler-Hammer, Inc., Milwaukee. Bituminous base compounded with filler such as asbestos; cold-molded into parts. Besides heat resistance (400-600 degrees Fahr.), nonflammability and dielectric strength (80-100 volts per mil), material has resistance to corrosion, high polish, tensile strength (2000-4000 lbs. per sq. in.) and low moisture absorption (2 per cent). Used for electrical and heat insulation.

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THIOKOL—Thiokol Corp., Yardville, N. J. Synthetic rubber, available in two types; furnished in powder or raw sheet form, corresponding to crude rubber; processed in manner similar to rubber. Principal properties are oil and corrosion resistance, resistance to shock and availability in colors. Used for hoses carrying oil or gasoline, gaskets, packing, pipeline rings, diaphragms, newspaper printing blankets, etc.

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TRANSITE—Johns-Manville, New York. Fireproof material in a variety of forms as hoods, dampers, baffles, electrical conduits where high dielectric strength is not required. Principal properties are resistance to corrosion, heat resistance, and nonflammability.

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UNISORB—Felters Co. Inc., Boston. Proper types of felt with or without vibration units according to job for vibration isolation and acoustical work; is corrosion resistant, flexible and shatterproof and can be produced in colors.

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UNYTE—Plaskon Co. Inc., Toledo, O. Urea-formaldehyde base, thermosetting material. Principal properties are translucence, low moisture absorption and nonflammability. Material is available in colors, free flowing, and capable of rapid cure.

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URALITE—Consolidated Molded Products Corp., Scranton, Pa. Urea-Formaldehyde base, thermosetting material; furnished in powder, for molding into parts. Besides translucence, high polish, and insolubility in water, material has dielectric strength (300-500 volts per mil), tensile strength (8000-13,000 lbs. per sq. in.), nonflammability and availability in colors. Used principally for decorative items.

V

1 2 10

VIBRACORK—Armstrong Cork Products Co., Lancaster, Pa. Resilient board of cork granules; furnished in board and panel forms; compressed and baked under pressure into parts. Three principal properties are corrosion resistance, heat resistance and low moisture absorption. Material is made in two densities for vibration dampening applications.

1 . 3 10

VIBRO-PLATE—Korfund Co. Inc., Long Island City, N. Y. Material has permanent elastic core, consisting of a combination of several resilient elements. Principal properties are corrosion resistance, shock resistance and low moisture absorption. Used for pads to be placed under legs or bases of machines.

. 2 . 4 . 6 . . . .

VICTOPAC—Victor Mfg. & Gasket Co., Chicago. Laminated sheet packing with asbestos base for stamping or cutting by hand into parts. Material has high corrosion resistance, flexibility, tensile strength (2500 lbs. per sq. in.), heat resistance, low moisture absorption, nonflammability, impact resistance and high compressive strength. Used for gasketing and packing.

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VICTOR—Victor Mfg. & Gasket Co., Chicago.

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Asbestos sheet, asbestos fiber base; furnished in sheets for stamping or cutting into parts. Material has corrosion resistance, flexibility, tensile strength,

1—Corrosion resistance; 2—High heat resistance; 3—Impact resistance; 4—High tensile strength; 5—High dielectric strength; 6—Nonflammable; 7—Takes high polish; 8—Translucence; 9—Available in colors; 10—Low moisture absorption

(300 lbs. per sq. in.), heat resistance, (700 degrees Fahr.), nonflammability, specific gravity of 0.9, high compressive strength, insolubility and some resilience. Used for packing, thermal insulation, and vibration absorption.

1 2 - - - - - - - - 10

Cork sheet; vegetable bark in sheet form for stamping and cutting into parts. Material has corrosion resistance, flexibility, heat resistance, (180 degrees Fahr.), low moisture absorption, specific gravity of 0.27, fair compressive strength, resilience. Used for fluid seals and vibration absorption.

- 2 - 4 - - - - - -

VICTORITE—Victor Mfg. & Gasket Co., Chicago. Vegetable fiber base, sheet packing; furnished for stamping or cutting by hand into machine parts. Material has flexibility, tensile strength, (3000 lbs. per sq. in.), heat resistance, (200 degrees Fahr.), nonflammability, impact resistance, specific gravity of .675; compressive strength (2000 lbs. per sq. in.), and resilience. Used for gasketing and packing.

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VINYLITE—Carbide & Carbon Chemicals Corp., New York.

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Filled; resinous conjoint polymer of vinyl chloride and vinyl acetate base, thermoplastic material; furnished in sheets, rods or tubes and powder for molding, machining, stamping or extruding into parts. Material is abrasion and corrosion resistant, can take high polish, has flexibility, availability in color, nonflammable, moderate dielectric strength and tensile strength (6000-12,000 volts per mil). Used for machine cabinets, electrical fixtures, etc.

1 - - - - 6 - - - 10

Unfilled; resinous base, thermoplastic material; furnished in sheets and coated paper; laminated coated cloth, powder, or rods and tubes; for molding, stamping or machining into parts. Besides resistance and nonflammability, material has flexibility, high polish, availability in colors, translucence, moderate tensile strength, and dielectric strength (650 volts per mil). Resistant to water acids and alkalies. Uses include machine cabinets, electrical fixtures, etc.

- 2 - - 5 - - - - 10

VITREOSIL — Thermal Syndicate Ltd., New York. Ceramic base (vitreous silica, 99.8 per cent pure), nonplastic material; furnished in sheet and powder forms or rods and tubes; molded or drawn into parts. Besides low thermal expansion, high dielectric strength and extremely high heat resistance (1900 degrees Fahr.), material has high polish, corrosion resistance, low moisture absorption, and translucence. Used where high resistance to electrical, thermal, and corrosion extremes are required.

1 2 - - - 6 - - - -

VITRIC-10—United States Stoneware Co., Akron, O. Ceramic base, nonplastic material; furnished in powder form for casting into parts, or as complete parts. Besides corrosion resistance, heat resistance (1000 degrees Fahr.) and nonflammability, material has compressive strength (3500 lbs. per sq. in.), dielectric strength (40 volts per mil) and availability in colors. Used for cementing and sealing.

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VULCABESTON—Colt's Patent Fire Arms Mfg. Co., Hartford, Conn. Hard rubber and asbestos base, thermosetting material; furnished in sheet and laminated forms or rods and tubes for machining into parts or supplied as complete parts. Besides heat resistance (750 degrees Fahr.), tensile strength (7000 lbs. per sq. in.) and dielectric strength (40 volts per mil), material has corrosion resistance and low moisture absorption. Uses include insulation and brake linings.

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VULCO—See AJAX

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VULCOID — Continental-Diamond Fibre Co., Newark, Del. Resinous base, thermoplastic material; furnished in sheets and laminated forms, or rods and tubes for machining, stamping or forming into parts. Besides low moisture absorption, dielectric strength (400 volts per mil, approx.), tensile strength (11,000 lbs. per sq. in.), material has resistance to abrasion, flexibility in some forms, heat resistance (275 degrees Fahr.), availability in colors (red, gray, black) and is shatterproof. Used for electrical insulation where arc resistance is important. For mechanical insulation where moderate moisture resistance is important.

W

1 - 3 - - - - - - -

WESTFELT—Western Felt Works, Chicago. Felt material; furnished in cut shapes according to user's specifications. Used for vibration dampening, deadening sound, insulating against heat and cold and filtering liquids, air and gases. Material also furnished as oil or dust seals for bearings.

See advertisement page 63D

- - 3 4 5 - - - - -

WILMINGTON FIBRE—Wilmington Fibre Specialty Co., Wilmington, Del. Cotton rag and paper, chemically treated, nonplastic material; furnished in sheet form or rods and tubes for machining or stamping into parts. Besides dielectric strength (200-400 volts per mil), tensile strength (12,000-15,000 lbs. per sq. in.) and resistance to shock, material has corrosion resistance, high polish and availability in colors. Used for electrical and mechanical insulation.

X

- 2 - - - - - - - -

X-L—Excelsior Leather Washer Mfg. Co. Inc., Rockford, Ill. Specially processed leathers for packing and other mechanical uses.

1—Corrosion resistance; 2—High heat resistance; 3—Impact resistance; 4—High tensile strength; 5—High dielectric strength; 6—Nonflammable; 7—Takes high polish; 8—Translucence; 9—Available in colors; 10—Low moisture absorption

Alphabetical Listing of Producers of Design Materials

Section I—Irons, Steel and Nonferrous Metals

(For properties, uses, etc., of each material, see Pages 15D-34D)

A

Acme Steel Co., 2840 Archer Ave., Chicago.
Stainless strip steels—ACME

Allan, A., & Son, 601 Bergen St., Harrison, N. J.
Copper lead-bearing alloy — ALLAN RED METAL

Allegheny-Ludlum Steel Corp., Pittsburgh.
Stainless steels—ALLEGHENY and ALLEGHENY METAL
Special alloy tool steels—ATLAS No. 93, PYTHON, SEMINOLE and TETON
Nondeforming tool steel—DEWARD
Carbon tool steel—POMPTON
High speed steel—LXX
Abrasion resistant alloys—DRAGON and TIOGA

Alloy Cast Steel Co., Marion, O.
Cast alloy steels — CAST ALLOY STEELS

Aluminum Co. of America, 634 Gulf Bldg., Pittsburgh.
Aluminum alloys—ALCOA

Aluminum Industries Inc., 2438 Beekman St., Cincinnati.
Aluminum base alloys—PERMITE

American Brass Co., Waterbury, Conn.
Aluminum bronze alloy—AMBRALOY
Copper-aluminum alloy—AVIALITE
Copper, aluminum and nickel alloy — TEMPALOY
Corrosion resistant alloys—AMBRAC, TOBIN BRONZE, ANACONDA EVERDUR and MUNTZ METAL

American Magnesium Corp., 2210 Harvard Ave., Cleveland.
Magnesium alloys—MAZLO

American Manganese Steel Div., The American Brake Shoe & Foundry Co., Chicago Heights, Ill.
Cast steels and welding rods—AMSCO

American Nickeloid Co., 23 Second street, Peru, Ill.
Pre-finished bonded sheet and strip—NICKELOID, CHROMALOID, BRASSOID, COPPEROID and other AMERICAN BONDED METALS

American Rolling Mill Co., Middletown, O.
Stainless and high tensile steels — ARMCO
High silicon steel—ARMCO TRAN-COR 60
Pure iron—ARMCO Ingot Iron
Galvanized sheet iron or steel—ZINCGRIP

American Smelting & Refining Co., Equitable Bldg., New York.
Cadmium-nickel bearing alloy—ASARCOLOY NO. 7

American Stainless Steel Co., Commonwealth Bldg., Pittsburgh.
Corrosion resistant alloys—American CAN

American Steel Foundries, 410 No. Michigan Ave., Chicago.
High strength cast steel—HYLASTIC

Ampco Metal Inc., 3830 West Burnham St., Milwaukee.
Corrosion and shock resistant alloys—AMPCO METAL

Amplex Mfg. Co., div. of Chrysler Corp., 6500 Harper Ave., Detroit.
(See Chrysler Corp.)

Anchor Drawn Steel Co., Latrobe, Pa.
High carbon steel—RED ANCHOR

Antaciron, Inc., Wellsville, N. Y.
Corrosion resistant alloy—ANTACIRON

Apex Smelting Co., 2554 Fillmore St., Chicago.
Zinc base die cast alloy—APEX

Apollo Steel Co., Apollo, Pa.
Copper-bearing steel—APOLLOY METAL

Aurora Metal Co., 614 West Park Ave., Aurora, Ill.
Aluminum bronze alloy—AUROMET

B

Babcock & Wilcox Co., 19 Rector St., New York.
Corrosion and heat resisting alloys—ADAMANTINE and ELVERITE

Babcock & Wilcox Tube Co., Beaver Falls, Pa.
Corrosion and heat resisting steel tubes—B & W CROLOY 2

Baker & Co. Inc., 54 Austin St., Newark, N. J.
Platinum alloy—BAKER

Bearium Metals Corp., 258 State St., Rochester, N. Y.
Bearium-processed lead alloys—BEARIUM

Beckett Bronze Co., Muncie, Ind.
High lead bronze—BECKETT METAL

Belle City Malleable Iron Co., Racine, Wis.
Pearlitic malleable iron — BELMALLOY

Bethlehem Steel Co., Bethlehem, Pa.
Corrosion resistant alloy steels — BETHADUR
Copper bearing steel—BETH-CU-LOY
Stainless steel—BETHALON
High carbon, manganese and nickel steels; and chromium-molybdenum steel castings—BETHLEHEM
Special carbon spring steel—ENDURIA
High temperature alloy steel—SUPERTEMP
Nickel chromium irons—MAYARI ALLOY IRON and MAYARI STEELS
Chromium-nickel-copper-silicon steel—MAYARI A

Binney Castings Co., 401 Phillips street, Toledo, O.
Heat resisting iron alloys and copper alloys—MIN-OX

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Alloy cast steels—BIRDSBORO

Bohn Aluminum & Brass Corp., Lafayette Bldg., Detroit.
Light aluminum alloy—BOHNALITE

Boker, H., & Co. Inc., 101 Duane St., New York.
High chromium steel—KINITE

Bonney-Floyd Co., Marion Rd., Columbus, O.
Alloy cast steel—BONNEY-FLOYD

Bound Brook Oil-less Bearing Co., Bound Brook, N. J.
Bearing bronzes—BOUND BROOK and COMPO

Bridgeport Brass Co., Bridgeport, Conn.
High copper silicon bronzes — DURONZE
Copper and zinc alloys—BRIDGEPORT

Buckeye Brass & Mfg. Co., 6410 Hawthorne, Cleveland.
Bearing bronzes—COMMERCIAL, HY-SPEED and LUBRICO

Bunting Brass & Bronze Co., Spencer and Carlton Sts., Toledo, O.
Bearing bronzes—BUNTING

Burgess-Parr Co., Freeport, Ill.
Acid resisting alloys—ILLIUM

C

Cadman, A. W., Mfg. Co., 2816 Smallman St., Pittsburgh.
Nickel bronze alloy—NICUITE
Babbitt metal—BEARITE and ACORN

Calorizing Co., The, Wilkinsburg Station, Pittsburgh.
Corrosion and heat resisting alloys—CALITE and CALITE-NIROSTA

Campbell, Wyant & Cannon Foundry Co., Muskegon Heights, Mich.
High strength cast irons—CANNONITE and PROFERALL

Cannon-Stein Steel Corp., 817 S. State St., Syracuse.
Manganese and chrome nickel steels—RITA
Corrosion and heat resistant alloy—CANNON 3½ per cent nickel steel

Carboloy Co., Inc., 2985 E. Jefferson Ave., Detroit.
Cemented carbide—CARBOLOY

Carnegie-Illinois Steel Corp., Carnegie Bldg., Pittsburgh.
Abrasion resisting alloy—AR STEEL

Carpenter Steel Co., Reading, Pa.
Carbon, chromium and chrome nickel steels—CARPENTER
Nickel-chrome steels—SAMSON

Castings Corp., 666 Andrews Bldg., Buffalo.
Corrosion and wear resisting malleable iron—Z-METAL

Corrosion and heat resisting alloys—STERLING

Cerro de Pasco Copper Corp., 44 Wall St., New York.
Bismuth-lead-tin-antimony castings — CERROMATRIX, CERROBASE and CERROBEND

Chace, W. M., Co., 1616 Beard Ave., Detroit.
Thermostatic metal—BIMETAL

Chapman Valve Mfg. Co., Indian Orchard, Mass.
Corrosion resisting iron — DAVIS METAL

Chase Brass & Copper Co., Waterbury, Conn.
Corrosion resistant copper alloys — OLYMPIC BRONZE, ADMIRALTY BRONZE, CHAMET BRONZE, and CHASE

Chambersburg Engineering Co., Chambersburg, Pa.
Nickel-molybdenum iron alloys — CECOLLOY

Chicago Steel Foundry Co., 3720 S. Kedzie Ave., Chicago.
Alloy cast steels—EVANSTEEL, and PYRASTEEL

Chrysler Corp., Amplex Div., 6500 Harper Ave., Detroit.
Bearing bronze—OILITE

Climax Molybdenum Co., 500 Fifth Ave., New York.
Molybdenum steel—MO-LYB-DEN-UM

Colmonoy Inc., P. O. Box 977, Los Nietos, Calif.
Corrosion and wear resisting alloys—COLMONOY

Columbia Steel & Shafting Co., Woodkrik St., Pittsburgh, Pa.
High tensile steel—COLUMBIA

Continental Roll & Steel Foundry Co., East Chicago, Ind.
Hard alloys for rolls — DUQUESNE SPECIAL, CROMONITE and HUBBARD SPECIAL
Alloy cast steels—DYNAMIC STEEL, MOLYBDENITE and TEMP ALLOY

Continental Steel Corp., Kokomo, Ind.
Case hardening steel—KONIK

Cooper Alloy Foundry Co., 150 Broadway, Elizabeth, N. J.
Corrosion and heat resisting cast alloys—COOPER ALLOY

Cramp Brass & Iron Foundries Co., Philadelphia.
Copper alloys—CRAMP ALLOYS

Crucible Steel Co. of America, 405 Lexington Ave., New York.
High strength alloy steels—DUPLEX, MAX-EL and SIMPLEX
Corrosion and heat resistant alloys—LO CRO and REZISTAL

D

Detroit Alloy Steel Co., 6500 Wight St., Detroit.
Alloy steel castings—KROKOLOY and CASTALOY
Oil hardening tool steel castings — CARBOMANG

Doehler Die Casting Co., 386 Fourth Ave., New York.
Copper-zinc-silicon alloys — DOLER-BRASS, DOLER-ZINK
Magnesium base alloys—DOLER-MAG
Aluminum base die castings—DOLER-ALUMIN

Dow Chemical Co., 919 Jefferson Ave., Midland, Mich.
Corrosion resistant light alloys—DOW-METAL

Driver-Harris Co., Harrison, N. J.
Corrosion, heat and wear resisting alloys — ADVANCE, NIREX, NILVAR, CHROMAX, CIMET, NICHROME, HYTEMCO and DRIVER-HARRIS 42 and 52 ALLOYS

Driver, Wilbur B., Co., Riverside Ave., Newark, N. J.
Nickel copper alloy—CUPRON
Nickel-chromium-iron—CROMIN D
Copper, nickel and manganese alloys—MANGANIN
Heat resistant wire—TOPHET

Duraloy Co., 12 E. 41st St., New York.
Corrosion and heat resisting alloys — DURALOY

Duriron Co. Inc., Dayton, O. (and licensees—see Duriron in tradename listing).
Corrosion and heat resistant alloys—ALCUMITE, DURICHLOR, DURIMET, DURIRON and DURCO

E

Electro-Alloys Co., Elyria, O.
Corrosion and heat resisting alloys—THERMALLOY

Electro Metallurgical Sales Corp., 30 East 42nd St., New York.
Ferro-alloy—ELECTROMET

Empire Steel Castings Co. Inc., Reading, Pa.
Corrosion, heat and wear resisting cast steel—EMPIRE

Erie Malleable Iron Co., Erie, Pa.
Abrasion and wear resisting malleable Iron—ERMAL and ERMALITE

F

Farrell-Cheek Steel Co., Sandusky, O.
Abrasion, wear and shock resisting cast steel—FARRELL's 85

Federal Mogul Corp., 11031 Shoemaker Ave., Detroit.
Bearing bronzes—FEDERAL MOGUL
Babbitt bearing alloys—MOGUL

Ferner, R. Y., Co., 161 Devonshire St., Boston.
Corrosion and heat resisting alloys—ELINVAR
Alloy with low coefficient of expansion—INVAR

Finkl, A., & Sons Co., 2011 N. Southport Ave., Chicago.
Special alloy steel—MOLYBDIE

Firth-Sterling Steel Co., McKeesport, Pa.
Carbon tool steels—STERLING
Cemented carbides—FIRTHITE

Fredericksen Co., Saginaw, Mich.
Bearing bronzes—SABECO and AGRICOLA

G

General Alloys Co., 367-405 W. First St., Boston.
Corrosion, heat and wear resisting alloys—X-ITE, X-7, Q-ALLOYS and ECONOMET

General Electric Co., Schenectady, N. Y. (and licensees—see Alnico in tradename listing).
Magnet alloy—ALNICO
Welding electrode—TRODALOY NO. 1

Graphite Metallizing Corp., Yonkers, N. Y.
Copper and babbitt metals—GRAPHITE

Gunite Foundries Corp., Rockford, Ill.
High test cast iron—GUNITE

H

Halcomb Steel Co., Syracuse, N. Y.
Stainless Steels—HALCOMB

Handy & Harman, 82 Fulton street, New York.
Brazing alloys—HANDY FLUX, SILFOS and EASY-FLO

Haynes Stellite Co., 205 E. 42nd St., New York.
Heat and wear resistant alloys — HAYSTELLITE, HAYNES STELLITE and HASCROME
Corrosion resistant alloy — HASTELLOY

Heppenstall Co., Hatfield St., Pittsburgh.
Abrasion resistant alloy steels—HARDTEM and KLEENKUT
High strength alloy steel—HEPPENSTALL
Nickel chrome molybdenum steel — PYRODIE

Hevi Duty Electric Co., 4212 W. Highland Blvd., Milwaukee.
Heat resistant element—ALLOY NO. 10

Hoskins Mfg. Co., 4445 Lawton Ave., Detroit.
Heating element alloys—CHROMEL

Hybinette, Victor, Wilmington, Del.
Nickel-chrome alloy—HYBNICKEL

I

Industrial Steel Casting Co., Div. of Unitcast Corp., Toledo, O.
Cast steels—TOLEDO ALLOY

Industrial Steels Inc., East Cambridge, Mass.
Stainless steels and irons — INDUSTRIAL, Nos. 35 and 12, respectively.

Ingersoll Steel & Disc Co., Division of Borg-Warner Corp., Straus Bldg., Chicago.
Stainless clad steel—INGACLAD

Inland Steel Co., 38 S. Dearborn St., Chicago.
High strength, corrosion resistant and copper bearing steels, and spring steel—INLAND HI-STEEL
Corrosion and abrasion resisting steel—LEDLOY

International Nickel Co. Inc., 67 Wall St., New York (and licensees).
Corrosion, heat and wear resisting alloys — NI-TENSYLIRON, NI-HARD, NI-RESIST, NICKEL, MONEL and INCONEL
High tensile strength alloy — HIGH TEST

J

Janney Cylinder Co., Holmesburg, Philadelphia.
Copper — zinc — aluminum — bronze — ALCOP BRONZE
Nickel bronze—NICKELDUR
Special alloy iron—FERRODUR
Special chromium steel — SUPARDCROME
Chromium alloy iron—JANNEY Pressure-tite iron
Manganese aluminum bronze — JANNEY Hightensile bronze
Corrosion resistant alloy — JANNEY Alloy No. 20

Jeffrey Mfg. Co., The, First avenue and Big Four railroad, Columbus, O.
High strength malleable irons—PERDURO and SUPERMAL

Jelliff, C. O., Mfg. Corp., Southport, Conn.
Resistance alloys—JELLIFF and KANTHAL

Jewell Alloy & Malleable Co., 373 Hertel Ave., Buffalo.
Heat resisting cast alloy — JEWELL-ALLOY

Johnson Bronze Co., New Castle, Pa.
Bearing metals—JOHNSON and LED-ALOYL

Jones & Laughlin Steel Corp., Jones & Laughlin Bldg., Pittsburgh.
High tensile steel—JAL-TEN
Free machining steel—JALCASE

K, L

Koppers Co., Bartlett-Hayward Div., Baltimore.
Bronze alloy—D-H-S BRONZE

Lake City Malleable Co., 5060 Lakeside Ave., Cleveland.
Malleable iron—SHOCK PROOF

Latrobe Electric Steel Co., Latrobe, Pa.
Nondeforming tool steel—MANGANO

Lebanon Steel Foundry, Lebanon, Pa.
Alloy cast steels—CIRCLE L

Lehigh Babbitt Co., Box 504, Allentown, Pa.
Graphite and babbitt metals—GRAPHO

Lincoln Electric Co., 12818 Coit Rd., Cleveland.
High tensile welding rods — SHIELD-ARC, LIGHTWELD, MANGANWELD, WEARWELD, HARDWELD, ABRASOWELD, TOOLWELD, and AERISWELD

Linde Air Products Co., 205 East 42nd St., New York.
Welding rods—OXWELD

Link-Belt Co., 220 S. Belmont Ave., Indianapolis.
Malleable cast iron—PROMAL

Lukens Steel Co., Coatesville, Pa.
Steels varying in analysis—LUKENS

Lumen Bearing Co., 297 Lathrop Ave., Buffalo.
Wear resisting—MACHINEBRONZE
High tin babbitt — STANNUM BABBITT
Lead base bearing babbitt — LOTUS BABBITT
Bearing alloys—LUMEN ALLOYS

M

Mackenzie's, Duncan, Sons Co., Inc., Trenton, N. J.
Heat resisting alloy — MACKENITE METAL

Mackintosh-Hemphill Co., 901 Bingham St., Pittsburgh.
Wear resisting steel and iron—ADAMITE
Wear resisting iron—IRALITE
High strength alloy steel—MACHEMPITE "Wearprooft"

Mallory, P. R., & Co. Inc., Indianapolis.
Hard surfacing material—MAL-ARC
Welding electrodes—ELKALOY
Wear resistant alloy—ELKONITE
Copper base alloys—MALLORY

Manganese Steel Forge Co., Allen street and Castor avenue, Philadelphia.
Forged alloy steel—ROL-MAN

Massillon Steel Casting Co., Massillon, O.
Alloy cast steel — MASSILLON and TIGERLOY
Nitriding steel—NITRALLOY

Maurath Inc., 7301 Union Ave., Cleveland.
Welding rod—MAURATH

McGill Mfg. Co., Valparaiso, Ind.
Corrosion resistant alloys—McGILL

Meehanite Metal Corp., Vandergrift Bldg., Pittsburgh. (and licensees—see Meehanite in tradename listing).
Abrasion and heat resisting alloy — MEEHANITE

Metal Carbides Corp., Youngstown, O.
Tungsten carbide metal—TALIDE

Metal & Thermit Corp., 120 Broadway, New York.
Welding electrodes—MUREX

Michiana Products Corp., Michigan City, Ind.
Corrosion and heat resisting alloys — FIRE ARMOR; MICHIANA; ZORITE

Michigan Steel Casting Co., Ft. of St. Aubin Ave., Detroit.
Heat and corrosion resisting alloys — MISCO and MISCROME

Midvale Co., Nicetown, Philadelphia.
Corrosion and heat resisting alloys—MIDVALOY

Moraine Products Div., General Motors Corp., 330 East First St., Dayton, O.
Bearing alloys — DUREX and MORAINE

Motor Castings Co., Milwaukee, Wis.
Nickel-chromium-molybdenum gray iron—MOCASCO 60

Mueller Brass Co., Port Huron, Mich.
Corrosion resisting alloys — TUFSTUFF and MUELLER 600 BRONZE
Brass for forging—RELLEUM BRASS

N

National Alloy Steel Co., Blawnox, Pa.
Corrosion and heat resisting castings—NA, NA-1, NA-2

National Lead Co., 111 Broadway, New York.
Babbitt metal for bearings — DUTCH BOY BABBITT; HOYT BABBITT METAL
White metal bearing alloy—SATCO

National Malleable & Steel Castings Co., 10600 Quincy Ave., Cleveland.
Alloy cast steel—NACO STEEL
Malleable cast iron—MALLIX

National Smelting Co., 6700 Grant Ave., Cleveland.
Aluminum alloy—NATIONAL

National Tube Co., Frick building, Pittsburgh.
Seamless steel tubing — NATIONAL TUBING

New Jersey Zinc Co., 160 Front St., New York.
Zinc alloys—ZAMAK

Newport Rolling Mill Co., Newport, Ky.
Copper-bearing pure iron—GOHI

Niagara Falls Smelting & Refining Corp., Buffalo.
Alloying elements — CATARACT METAL, and NIAGARA

Nicralumin Co., Jackson, Mich.
Light aluminum alloys—NICRAL

Nitralloy Corp., 230 Park Ave., New York (and licensees—see Nitralloy in tradename listing).
Nitriding steel—NITRALLOY

Nitricastiron Corp., 230 Park Ave., New York (and licensees—see Nitricast-iron in tradename listing).
Cast iron—NITRICASTIRON

O, P

Ohio Steel Foundry Co., Springfield, O.
Corrosion and heat resisting alloys—FAHRITE
Alloy cast steels—HIOLOY

Pacific Foundry Co., 2100 Nineteenth St., San Francisco.
Corrosion and wear resisting cast alloys—FLINTCAST and PYROCAST

Permold Co., 6700 Grant avenue, Cleveland.
Permanent mold aluminum castings—PERMOLD

Phelps Dodge Copper Products Corp., 40 Wall St., New York.
High tensile silicon bronze — PMG METAL

Pioneer Alloy Products Co. Inc., 16601 Euclid Ave., Cleveland.
Heat resisting alloy — PIONEER METAL

Precision Castings Co. Inc., Syracuse, N. Y.
Aluminum base alloys—PRECISION

Q, R

Q & C Co., 90 West St., New York.
Heat and abrasion resisting alloy — NOGROTH

Reading Iron Co., 404 N. Broad St., Philadelphia.
Bar iron—NORDIC IRON

Republic Steel Corp., Republic Bldg., Cleveland.
Open hearth iron alloy — TONCAN IRON
Stainless and heat resisting alloys — ENDURO
High strength alloy — AGATHON

Resisto-Loy Co., Grand Rapids, Mich.
Corrosion and abrasion resistant ISOROD, RESISTO-LOY

Revere Copper & Brass Inc., 230 Park Ave., New York.
Non-magnetic, corrosion resistant, silicon bronze—HERCULOY
Bearing bronze—ROMAN BRONZE

Rhoades, R. W., Metaline Co. Inc., P. O. Box No. 1, Long Island City, N. Y.
Heat resisting bearing bronze—METALINE

Riverside Metal Co., Riverside, N. J.
Copper-tin-nickel-zinc alloy — RIVERSIDE

Ruselite Corp., 1025 N. Fourth St., Milwaukee, Wis.
High tensile bronze — TANTALUM BRONZE

Rustless Iron & Steel Corp., 3400 East Chase St., Baltimore.
Chrome and chrome nickel stainless steels — DEFIRUST, DEFIHEAT, DEFISTAIN and RUSTLESS 17
Hardening type stainless steel — RUSTLESS

Ryerson, Jos. T., & Son Inc., Sixteenth and Rockwell streets, Chicago.
Specially processed lead base alloys—GLYCO BABBITT

S

Sandusky Foundry & Machine Co., Sandusky, O.
Nickel-chrome and molybdenum cast iron alloys — SANDUSKY ALLOY IRON
Bronze, brass and manganese bronze alloys—SANDUSKY BRONZES

Scovill Mfg. Co., Waterbury, Conn.
Copper alloys—ADNIC and ALCUNIC
Hardware bronze—SCOVILL
Spring material—OREIDE

Seitzinger's, T. F., & Sons, 900 Ashby, Northwest, Atlanta, Ga.
Bearing bronze—DIXOILBRONZ

Seymour Mfg. Co., Seymour, Conn.
High corrosion resisting alloys — SEYMOUR and SEYMOURITE

Shawinigan Chemicals Ltd., Montreal, Que.
Heat and corrosion resistant alloys — SHAWINIGAN

Sheet Aluminum Corp., Jackson, Mich.
Corrosion and heat resisting alloys—HYB-LUM

Sivyer Steel Casting Co., 1675 S. 43rd St., Milwaukee.
Corrosion and heat resisting cast steels —SIVYER
Abrasion resisting cast steel—SIVYER
Alloy cast steels—SIVYER

Smith Steel Foundry Co., 1320 S. First St., Milwaukee.
High magnetic permeability alloy — SMITH DYNAMO STEEL

Standard Alloy Co., 1679 Collamer Ave., Cleveland.
Corrosion and heat resisting alloys—STANDARD-ALLOY

Stoody Co., Whittier, Calif.
Wear resisting alloys — STOODITE, STOODITE (Numbered), STOODY (Self-Hardening), SILFRAM and BORIUM

Sumet Corp., 1543 Filmore Ave., Buffalo.
Bronze bearings—SUMET

Summerill Tubing Co., Bridgeport, Montgomery Co., Pa.
Seamless tubing—SUMMERILL

Superior Steel Corp., Carnegie, Pa.
Stainless strip steel — SUPERIOR STAINLESS

T

Taylor-Wharton Iron & Steel Co., High Bridge, N. J.
Corrosion and abrasion resistant alloys—TISCO
Austenitic wear resisting steel — TIMANG

Timken Steel & Tube Division, The Timken Roller Bearing Co., Canton, O.
Creep resisting alloy steels — DM STEEL and SICROMO STEEL

Titanium Alloy Mfg. Co., Niagara Falls, N. Y.

Extra low carbon trimming steel — TAMCO

True Alloys Inc., 1820 Clay St., Detroit.
Aluminum-bronze alloys—TRUALOY

U, V

Union Drawn Steel Div., Republic Steel Corp., Massillon, O.
Cold drawn steels—UNION
Free-machining steels—UMA

Union Metal Mfg. Co., Canton, O.
Seamless steel tubing—UNION METAL

Union Steel Casting Co., Sixty-second and Butler Sts., Pittsburgh.
Alloy cast steel—UNIVAN

United States Graphite Co., Saginaw, Mich.
Bearing bronze—GRAMIX

United States Steel Corp., 434 Fifth Ave., Pittsburgh.
Stainless steels, Shelby tubing, castings, and electrical steel sheets — USS
Atmospheric corrosion and abrasion resistant-alloys — COR-TEN, SILTEN and MAN-TEN

Universal Cyclops Steel Corp., Titusville, Pa.
Corrosion and heat resisting alloys—CYCLOPS; UNILOY
Nondeforming tool steel — CYCLOPS WANDO
Special alloy tool steel — CYCLOPS ORION

Vanadium-Alloys Steel Co., Latrobe, Pa.
High strength alloy steels—NIKRO-M
Nitriding steel—NITRALLOY
Abrasion resistant—MACALLOY

W

Washington Iron Works, 1620 Sixth St. S., Seattle, Wash.
High strength alloy steels—SUPERLOY

Waukesha Foundry Co., North Chicago, Ill.
Copper-base alloy—WAUKESHA

Weatherly Foundry & Mfg. Co., Weatherly, Pa.
Heat and abrasion resisting alloys — DIAMITE and MOLY-IRON

Webb Wire Works, New Brunswick, N. J.
Stainless spring wire—WEBB ORANGE LABEL "SHIP BRAND"
Music wire for springs—WEBB BLUE LABEL

Wellman Bronze & Aluminum Co., 6017 Superior Ave., Cleveland.
Copper-tin-zinc-lead alloys — IDEALOY and ANFRILOY
Aluminum-silicon-titanium alloy — WELLCAST 17S

West Steel Casting Co., 805 E. 70th St., Cleveland.
Molybdenum-vanadium-nickel alloy — CUMLOY
High tensile strength alloy — DURACAST

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Corrosion and heat resisting alloy — KONAL and PHOS-COPPER
Magnetic alloy—HIPERNIK
Gas type metal—KOVAR
Copper base alloy—CUPALOY

Wheeling Steel Corp., Wheeling, W. Va.
Copper-steel—COP-R-LOY

Wheelock, Lovejoy & Co. Inc., 128 Sidney St., Cambridge, Mass.
Machinery steels—ECONOMO and HY-TEN

Wilcox-Rich Div., Eaton Mfg. Co., 9771 French Road, Detroit.
Corrosion and abrasion resistant alloys —WILRICH and XALOY

Williams, E. A., & Son Inc., 111 Plymouth St., Jersey City, N. J.
Babbitt metals for bearings—CLOVER-LEAF, DIAMOND G BRONZE and MILL BRASS MIX

Wilson, H. A., Co., Newark, N. J.
Thermostatic bimetal—THERMOMETAL and WILSON Contacting Materials

Wolverine Tube Co., 1411-1491 Central avenue, Detroit.
Tubing—WOLVERINE

Wood, Alan, Steel Co., Conshohocken, Pa.
High strength steel—"AW" DYN-EL
Rolled steel floor plate—"AW"

Worthington Pump & Machinery Corp., Harrison, N. J.
Corrosion and heat resisting cast iron —WORTHITE

Y

Youngstown Sheet & Tube Co., Youngstown, O.
High strength alloy steel—YOLOY

Section II—Plastics and other Nonmetallics

(For properties, uses, etc., of each material see Pages 35D-42D)

A

Advance Solvents & Chemical Corp., 245 Fifth Ave., New York.
Transparent molding material—RESOGLAZ

Aetna Rubber Co., E. 79th St., Cleveland.
Hard rubber—AETNA

American Cyanamid Co., Beetleware Div., 30 Rockefeller Plaza, New York.
Urea formaldehyde plastic—BEETLE

American Felt Co., 315 Fourth avenue, New York.
Felt material—"K" FELT

American Hard Rubber Co., 11 Mercer St., New York.
Hard rubber—ACE

American Phenolic Corp., 1250 West Van Buren street, Chicago.
Phenolic plastic—AMPHENOL

American Plastics Corp., 50 Union Square, New York.
Casein plastic—AMEROID

Armstrong Cork Products Co., Lancaster, Pa.
Cork and synthetic rubber compound—CORPRENE
Resilient board of cork granules—VIBRACORK

Atlas Powder Co., Zapan Div., Stamford, Conn.
Cloth base and Bakelite resinous plastic—REVOLITE

B

Bakelite Corp., 247 Park Ave., New York.
Phenolic plastics—BAKELITE

Booth Felt Co., 444—19th St., Brooklyn, N. Y.
Wool base felt—BOOTH FELT

Bound Brook Oil-less Bearings Co., Bound Brook, N. J.
Material for impregnated wood bushings, etc.—NIGRUM

Brandywine Fibre Product Co., 1404 Walnut street, Wilmington, Del.
Chemically-treated paper—BRANDYWINE FIBRE

C

Carbide & Carbon Chemicals Corp., 30 E. 42nd St., New York.
Resinous plastic—VINYLITE

Catalin Corp., 1 Park Ave., New York.
Phenolic plastics—CATALIN, PRYSTAL

Celluloid Corp., 290 Ferry St., Newark, N. J.
Cellulose acetate plastic—LUMARITH
Cellulose nitrate plastic—CELLULOID

Chicago Rawhide Mfg. Co., 1301 Elston avenue, Chicago.
Synthetic rubber compounds — SIRVENE
Heat resisting leather—SIRVIS

Colt's Patent Fire Arms Mfg. Co., 17 Van Dyke Ave., Hartford, Conn.
Hard rubber and asbestos base material—VULCABESTON

Consolidated Molded Products Corp., 309 Cherry St., Scranton, Pa.
Shellac base material—LACANITE
Phenolic plastic—ARCOLITE
Urea formaldehyde plastic—URALITE

Continental Diamond Fibre Co., Newark, Del.
Phenolic plastic—DILECTO and DIAMOND
Resinous plastic — VULCOID, DILOPHANE, CELLANITE and CELORON
Vulcanized fibre—CODITE
Fibrous, flexible material—MICABOND

Cork Insulation Co. Inc., 155 East 44th St., New York.
Isolation corkboard—CORINCO

Corning Glass Works, Corning, N. Y.
Ceramic base glass—PYREX GLASS

Cutler-Hammer Inc., 12th and St. Paul, Milwaukee.
Bituminous plastic—THERMOPLAX
Asbestos base material—PYROPLAX

D

Dow Chemical Co., Midland, Mich.
Plastic granules—ETHOCEL
Cellulose ether base, thermoplastic—ETHOFOIL

Du Pont de Nemours, E. I., & Co. Inc., Wilmington, Del.
Chloroprene rubber—NEOPRENE

Plastic coated wire mesh—CEL-O-GLASS
Nitrocellulose base—PYRALIN
Polymethyl-methacrylate base — LUCITE
Cellulose acetate base—PLASTACELE

Durite Plastics, Div. of Stokes & Smith Co., 5010 Summerdale Ave., Philadelphia.
Phenol-furfural plastic—DURITE

Excelsior Leather Washer Mfg. Co. Inc., Rockford, Ill.
Specially processed leather—X-L

F

Farley & Loetscher Mfg. Co., Dubuque, Iowa.
Phenolic and urea plastic—FARLITE
Fibrous core with laminated Bakelite surface—FARLITE LOETEX

Felters Co. Inc., 210 South St., Boston.
Laminated felt—DUFFELT
Felt for vibration isolation, etc.—UNISORB
Felt for grease & oil retention—FELTERS CERTIFIED FELT

Formica Insulation Co., 4613 Springs Grove Ave., Cincinnati, O.
Laminated resinous plastic—FORMICA

Franklin Fibre-Lamitex Corp., 190 East Twelfth street, Wilmington, Del.
Phenolic base, thermosetting material—LAMITEX

G

Garfield Mfg. Co., Garfield, N. J.
Thermosetting materials — GUMMON (black); HEMIT (gray-white); TEGIT (brown or black)

Gemloid Corp., 425 Fourth avenue, New York.
Thermoplastic material — GEMLOID (Enameloid Cloisonnette)

General Electric Co., 1 Plastics Ave., Pittsfield, Mass.
Nonrefractory and refractory materials—CETEC: Two types

General Electric Co., Schenectady, N. Y.
Phenolic plastic—TEXTOLITE

General Plastics Inc., North Tonawanda, N. Y.
Phenolic plastic—DUREZ

Goodrich, B. F., Co., Akron, O.
Synthetic rubber—KOROSEAL

H, I, J

Haskelite Mfg. Corp., 208 Washington St., Chicago.
Waterproof plywood — HASKELITE and PLYMETAL

Haveg Corp., Newark, Del.
Phenolic plastic—HAVEG
Phenol formaldehyde plastic—HAVEGIT

International Balsa Corp., 96-100 Boyd avenue, Jersey City, N. J.
Lightweight wood—BALSA

Johns-Manville, 22 East 40th St., New York.
Diatomaceous silica material—CELITE
Rubbery, asphaltic-asbestos material—AERTITE
Asbestos, fiber, graphite and rubber compound—EEL-SLIP
Weatherproof coating — INSULKOTE
Fireproof material—TRANSITE

K

Knight, Maurice A., Kelly Ave., Akron, O.
Depolymerized colloidal resin plastic—PYROFLEX
Corrosion resistant stoneware — KNIGHT-WARE

Korfund Co. Inc., 58-15—32nd Place, Long Island City, N. Y.
Finely granulated compressed cork plates—KOMPO-KORK
Resilient mat of pure natural cork—KORFUND
Finely granulated cork and rubber—KORK-RUBBER
Permanent elastic cork material—VIBRO-PLATE

L, M

Lignotite Co., 2727 Archer Ave., Chicago.
Casein plastic—LIGNOTITE

Luzerne Rubber Co., Dewey street, Trenton, N. J.
Hard rubber, thermoplastic—LUZERNE HARD RUBBER

Makalot Corp., 262 Washington St. Boston.
Synthetic resin plastic—MAKALOT

Marblette Corp., 3721 Thirtieth St., Long Island City, N. Y.
Phenolic plastic—MARBLETTE

Mica Insulator Co., 200 Varick St., New York.
Phenolic plastic—LAMICOID
Varnished cambric cloth—EMPIRE
High resistant and high dielectric—MICANITE

Monroe Auto Equipment Co., Monroe, Mich.
Bituminous base liquid for spraying parts—SPRAYTEX

Monsanto Chemical Co., Plastics Div., Indian Orchard, Mass.
Cellulose nitrate plastic—FIBERLOID, FIBESTOS and MONSANTO CN
Phenolic plastic — FIBERLON and MONSANTO CP
Cellulose acetate plastic—MONSANTO CP
Polyvinyl acetal plastic—MONSANTO VA

N

National Carbon Co. Inc., Madison Ave. & W. 117th St., Cleveland.
Carbon or graphite in amorphous or graphitic form — NATIONAL CARBON

National Vulcanized Fibre Co., Wilmington, Del.
Laminated Bakelite—PHENOLITE
Cotton cellulose base, vulcanized fiber—NATIONAL FIBRE, NATIONAL SWITCH INSULATION
Cotton rag base, fish paper insulation—PEERLESS

Nixon Nitration Works, 126 Murray street, East Nixon, N. J.
Thermoplastic materials—NIXONOID and NIXON

O, P

Owens-Illinois Glass Co., Newark, O.
Glass, in fibrous form — O-I FIBER GLAS

Panelyte Corp., 230 Park avenue, New York.
Synthetic laminated resinous material—PANELYTE

Penn Fibre & Specialty Co., 912 South Front street, Philadelphia, Pa.
Phenol and vulcanized fiber—PENN

Plaskon Co., Inc., 2112 Sylvan Ave., Toledo, O.
Urea formaldehyde plastic—PLASKON and UNYTE

Polaroid Corp., 286 Columbus Ave., Boston.
Light-polarizing glass—POLAROID

R

Reilly Tar & Chemical Corp., Merchants Bank Bldg., Indianapolis.
Phenolic plastic—INDUR, INDUR VARNISH

Resinox Corp., 17 Battery Place, New York.
Phenolic plastic—RESINOX

Richardson Co., The, Melrose Park, Ill.
Thermosetting plastic—INSUROK
Hard rubber—RUB-TEX
Acid-resisting bituminous plastic — EBROK

Robertson, H. H., Co., Grant Bldg., Pittsburgh, Pa.
Felt bonded to metal—ROBERTSON FELT-BONDED METAL

Rohn & Haas Co. Inc., 222 W. Washington Sq., Philadelphia.
Acrylic base plastic—PLEXIGLAS and CRYSTALLITE

Ryerson & Son Inc., Jos. T., Sixteenth and Rockwell streets, Chicago.
Bearing material—RYERTEX

S

Self-Vulcanizing Rubber Co. Inc., 605 W. Washington Blvd., Chicago.
Gum rubber base material, in liquid form—AIRVULC
Cold curing gum rubber, liquid form—SELFVULC

Siemon Co., Bridgeport, Conn.
Shellac base plastic—HARVITE

Spaulding Fibre Co. Inc., Tonawanda, N. Y.
Fibrous material—SPAULDING FIBRE, SPAULDING ARMITE, SPAULDO
Phenolic plastic—SPAULDITE

Specialty Insulation Mfg. Co. Inc., Hoosick Falls, N. Y.
Resinous material compounded with rubber—COLASTA No. 56

Stokes & Smith Co. (Durite Plastics Div.), Philadelphia.
Phenol furfural plastic—DURITE

Synthane Corp., Oaks, Pa.
Laminated Bakelite—SYNTHANE

Synthetic Plastics Co., Newark, N. J.
Casein plastic—KASOLOID

T

Taylor Fibre Co., Norristown, Pa.
Phenolic base thermosetting material—TAYLOR FIBRE

Tennessee Eastman Corp., Kingsport, Tenn.
Cellulose acetate plastic—TENITE

Thermal Syndicate Ltd., 12 East Forty-sixth street, New York.
Ceramic base, nonplastic—VITREOSIL

Thiokol Corp., Yardville, N. J.
Synthetic rubber—THIOKOL

U, V

United States Stoneware Co., Akron, O.
Ceramic base, nonplastic—VITRIC-10

Victor Mfg. & Gasket Co., 5750 Roosevelt road, Chicago.
Laminated sheet packing—VICTOPAC
Vegetable fiber base sheet packing—VICTORITE
Asbestos sheet—VICTOR
Cork sheet—VICTOR

Vulcanized Rubber Co., 261 Fifth Ave., New York.
Hard rubber—AJAX

W

Watertown Mfg. Co., Watertown, Conn.
Phenolic plastic—NEILLITE

Western Felt Works, 4117 Ogden St., Chicago.
Felt material—WESTFELT

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Phenolic plastic—MICARTA

Wilmington Fibre Specialty Co., Wilmington, Del.
Paper base material—FYBEROID
Cotton rag and paper, nonplastic — WILMINGTON FIBRE
Phenolic plastic—OHMOID

Stampings Producers

Reference letters beneath addresses of companies refer to: (a) Types, materials and sizes of stampings; (b) Names of stamped machine parts customarily produced; and (c) Machining, heat treating or assembling facilities.

A

Accurate Spring Mfg. Co., 3811 West Lake street, Chicago.
(a) Blanking, forming and perforating all metals, small and medium sizes, specializing in spring materials.
(b) Springs of various types.
(c) Complete facilities.

Ace Hardware Mfg. Corp., The George Jones Co., 2020 East Orleans street, Philadelphia.
(a) Flat, drawn and formed stampings of all materials, 5 to 75 tons pressure capacity. Sizes 20 in. square light and heavy gages.
(b) To customers' specifications.
(c) Complete facilities.

Acklin Stamping Co., 1925 Nebraska avenue, Toledo, O.
(a) Pressed metal parts from steel brass and aluminum to 40 in. dia., .010 to ⅝ in. metal thickness.
(b) To customers' specifications.
(c) Complete facilities.

Advance Stamping Co., 7075 Lyndon avenue, Detroit.
(a) Stampings from .062-in. stock, 3 in. blank dia.
(b) Special eyelets, small shells, hinge lid oilers, etc.
(c) Assembling facilities.

Akron Metallic Gasket Co., 162 North Union street, Akron, O.
(a) Small light metal stampings.
(b) Gaskets, washers, and shims.
(c) Machining facilities.

Aluminum Goods Mfg. Co., Washington street, Manitowoc, Wis.
(a) Aluminum stampings, spinnings and deep drawings.
(b) Refrigerator, radio, textile, electrical, and automotive parts.
(c) Complete facilities.

American Aluminum Ware Co., 368-378 Jelliff avenue, Newark, N. J.
(a) Aluminum industrial stampings.
(b) Spools, reflectors, boxes, tubes, etc.
(c) None.

American Emblem Co, Inc., Box D 116, Utica, N. Y.
(a) Art metal and intricate stampings up to 16 in. square; .003 to .250-in. metal thickness.
(b) Embossed nameplates, radio escutcheons and dials and ornamental stampings.
(c) Complete facilities.

American Pulley Co., 4200 Wissahickon avenue, Philadelphia.
(a) Pressed steel stampings in light to heavy steel gages; also deep drawn stampings.
(b) To customers' specifications.
(c) Complete facilities.

American Stamping Co., 22 Custom House street, Boston.
(a) Stamping, drawing and forming, up to ¼-in. thick.
(b) Automotive parts.
(c) None.

American Stamping Co., 978 East Sixty-fourth street, Cleveland.
(a) Light and heavy stampings.
(b) Automotive parts.
(c) Facilities for light assembly.

Amesbury Metal Products Co. Inc., 39 Oakland street, Amesbury, Mass.
(a) Steel stampings from deep drawn and cold rolled steel.
(b) Automobile and marine lamp equipment, clock cases, vending machine cabinets and mechanisms.
(c) Complete facilities.

Anderson, O. L., Co. Inc., 1347 Fort street East, Detroit.
(a) Sheet steel stampings to 11 gage. (Presses up to 122 in. in length)
(b) Automobile and truck parts.
(c) None.

Arkansas Machine Specialty Co., Hope, Ark.
(a) Any metal stampings light enough for presses to 50 tons capacity.
(b) To customers' specifications.
(c) Complete facilities.

B

Barnes-Gibson-Raymond Div., Associated Spring Corp., 6391 Miller avenue, Detroit. (The Cook Plant—Ferry Field and Boulevard drive, Ann Arbor, Mich.)
(a) Small flat springs and stampings from carbon and alloy steels and nonferrous metals.
(b) Special small stampings, formed flat wire parts, catches, clips, contacts, snap rings, retainers and washers.
(c) Complete facilities.

Barth Stamping & Machine Works, 3815 West Thirty-fourth street, Cleveland.
(a) Light and medium sheet metal stampings.
(b) To customers' specifications.
(c) Machining facilities.

Bay State Stamping Co., 380 Chandler street, Worcester, Mass.
(a) Steel, brass, aluminum, etc., up to 6 in. dia. in flat pieces, and 3 in outside dia. by 3 in. high in cupped-up pieces.
(b) Ferrules.
(c) Heat treating and assembling facilities.

Beckley Perforating Co., 100 North avenue, Garwood, N. J.
(a) All types of perforated metals.
(b) Stone and quarry screens, welded open pressure and storage tanks, and machine guarding of all types
(c) None.

Bellevue Mfg. Co., The, Bellevue, O.
(a) Deep drawn to 12 in., and general small stampings.
(b) Automotive.
(c) Annealing, enameling, plating and assembling.

Boehm Pressed Steel Co., 2210 West Sixty-Third street, Cleveland.
(a) All types of medium stampings
(b) To customers' specifications.
(c) Complete facilities.

Bossert Co. Inc., The, 1002 Oswego street, Utica, N. Y.
(a) Stampings from .005 to 1 in. in thickness, any metal.
(b) Automotive, refrigeration, washing machine, radio, etc.
(c) Assembling and welding facilities.

Bowen Products Corp., 4647 Fourth street, Ecorse, Mich.
(a) Heavy, medium and light stampings, 6 in. max., length draw, 8 in. max. dia.
(b) Shells, bushings, sockets, etc.
(c) Complete facilities.

Bridgeport Brass Co., 774 East Main street, Bridgeport, Conn.
(a) Brass and copper shells drawn to 6 in. dia., 36 in. long; blanked and formed shells.
(b) To customers' specifications.
(c) Polishing, plating and assembling facilities.

Budd, Edward G., Mfg. Co., Philadelphia. (Detroit branch located at 12141 Charlevoix avenue).
(a) Automobile body and small special stainless steel stampings.
(b) Automotive, chemical and rayon, rail cars, commercial trailers, marine and aircraft fields.
(c) Complete facilities.

Burgess Co. Inc., The, Twelfth street and Eleventh avenue, Beaver Falls, Pa.
(a) Medium, large and small stampings in all materials and types.
(b) To customers' specifications.
(c) Complete machining facilities.

Burgess-Norton Mfg. Co., Geneva, Ill.
(a) Steel stampings, flat, drawn or formed. (Presses of 125-ton capacity and smaller.)
(b) Automotive parts.
(c) Complete facilities.

C

Chapin, The R. E., Mfg. Works Inc., 29 Liberty street, Batavia, N. Y.
(a) Blanks to 26 in. dia. light gage.
(b) Sprayers, atomizers, pumps.
(c) Machining.

Chase Brass & Copper Co. Inc., 236 Grand street, Waterbury, Conn.
(a) All type sheet metal stampings; drawn shells of brass, copper and copper alloys.
(b) All types of parts.
(c) Machining, polishing and plating facilities.

City Auto Stamping Co., Lint and Dura Avenues, Toledo, O.
(a) Large light gage stampings.
(b) Automotive.
(c) Assembling facilities.

Cleveland Metal Stamping Co., 3110 Payne avenue, Cleveland.
(a) Light stampings not over 1½ draw, ⅛-in. thick material.
(b) All shapes of machine parts.

(c) Drilling, tapping, milling and assembling facilities.

Cleveland Pressed Steel Co., 2953 East Fifty-fifth street, Cleveland.
(a) Small and medium stampings from any material.
(b) Variety of parts.
(c) Adequate facilities.

Cleveland Steel Products Corp., Plant No. 2, Wellington, O.
(a) All types to 12 in. draw, 12 in. dia., ¼ in. thick.
(b) Automotive, radio, industrial and electrical.
(c) Complete secondary operation, cyanide hardening, assembling, and plating.

Cogswell Mfg. Co. Inc., 140 Norman street, West Springfield, Mass.
(a) Cold-rolled steel, stainless steel, brass and aluminum stampings.
(b) Electric switch parts, etc.
(c) Well equipped for spot welding and plating.

Commercial Shearing & Stamping Co., 1775 Logan street, Youngstown, O.
(a) To 60 in., ¾-in. gage, steel and copper alloys, aluminum and stainless steel.
(b) Tank heads and other heater parts.
(c) Machining and assembling facilities.

D

Dahlstrom Metallic Door Co., Buffalo street, Jamestown, N. Y.
(a) Steel, brass, bronze, aluminum stampings and drawn parts. (Press equipment Bliss 3-B to 7-E, and brake presses for sections 10 to 12 ft. long).
(b) Machine guards, cabinets, latches, brackets and special parts.
(c) Complete heat treating, limited assembling.

Davis Brake Beam Co., Johnstown, Pa.
(a) Medium stampings, 10 gage and lighter, to 20 x 40 in.; also hot pressings 3/16-in. and lighter.
(b) Refrigerators, stoves and institutional equipment.
(c) Complete facilities.

Defiance Pressed Steel Co., Otis and Cheney streets, Marion, O.
(a) Small and medium sized stampings.
(b) Automobile parts, heaters and steering wheels.
(c) Complete assembling facilities.

Detroit Stamping Co., 3445 West Fort street, Detroit.
(a) From ¼-in. to blanks 36 x 45 in., max. 3 in. draw; heavy blanking presses for ⅜-in. thick stock; in nonferrous metals.
(b) To customer's specifications.
(c) Drilling, tapping, lathe trimming, and spot welding.

Dill Mfg. Co., The, 700 East Eighty-second street, Cleveland.
(a) Small brass and steel stampings.
(b) Ferrules, rubber inserts, valves and valve parts, etc.
(c) None.

Dominion Electrical Mfg. Inc., 22 Elm street, Mansfield, O.
(a) Small and medium light-gage steel stampings.
(b) Household appliances.
(c) Drill press, complete plating and assembling.

E

Eaton Mfg. Co., Stamping Division, Cleveland.
(a) Steel and brass stampings, to 18 in. dia. blank and .25 thick.
(b) All types of stampings.
(c) Annealing, brazing and welding facilities.

Ellis, George D., & Sons Inc., 309 North Third street, Philadelphia.
(a) Tinplate, steel, copper, aluminum and brass stampings, under 20 gage.
(b) Knitting and weaving machine, vending machine parts, etc.
(c) Machining and assembling facilities.

Ennen, Geo. L., Co., 7 Emerick street, Ypsilanti, Mich.
(a) Small steel stampings.
(b) Automotive.
(c) None.

Erie Art Metal Co., Eighteenth and Schaal avenue, Erie, Pa.
(a) All type sheet metal stampings, ferrous and nonferrous.
(b) Vault boxes, refrigerator cabinets, steel stove parts, etc.
(c) Machining and assembling facilities.

Eureka Tool & Machine Co., 27 West Fifty-fifth street, New York.
(a) Small and medium metal stampings.
(b) To customers' specifications.
(c) Complete facilities.

F

Faries Mfg. Co., 1036 East Grand avenue, Decatur, Ill.
(a) Brass, copper, aluminum and steel stampings, ⅜ in. to 24 in. square.
(b) Electrical fixtures, spinnings, screw machine products, etc.
(c) Annealing facilities.

Fitzsimmons Mfg. Co., 3104 East Woodbridge street, Detroit.
(a) Small and medium stampings.
(b) Automotive, refrigerator and general parts.
(c) Complete facilities.

Fox Co., Fox building, Cincinnati.
(a) Any size, shape of metal stampings.
(b) Nameplates, hub caps, etc.
(c) Assembly facilities.

Fullman Mfg. Co., 1209 Jefferson street, Latrobe, Pa.
(a) Steel, brass, aluminum, etc., ⅛-in thick, not over 18 x 18 in.
(b) Brackets, plates and shells.
(c) Machining and assembling facilities.

G

G. & G. Mfg. Co., The, 2530 Spring Grove avenue, Cincinnati.
(a) All types and materials. (Press capacity to 225 tons, 14 in. stroke).
(b) Automobile, radio, refrigerator, etc.
(c) Complete facilities.

General Metal Products Co., 3883 Delor street, St. Louis, Mo.
(a) Deep drawn, small and large stampings.
(b) To customers' specifications.
(c) Complete facilities.

Geometric Stamping Co., The, 1111 East 200th street, Cleveland.
(a) Any type sheet metal stamping in steel, stainless steel, brass, etc., ½ in. thick, 48 x 84 in.
(b) Dairy, washing machine, radio, railroad and automobile parts, etc.
(c) Complete facilities.

Geuder, Paeschke & Frey Co., 324 North Fifteenth street, Milwaukee.
(a) Deep drawn in all metals to 48 in. dia., 18 in. deep, 12 to 30 gage.
(b) Business and vending machine cases, tubs for electric washers, switch and transformer cases.
(c) Complete facilities.

Globe Machine & Stamping Co., 1250 West Seventy-sixth street, Cleveland.
(a) Metal stampings of all sizes.
(b) Various types of parts.
(c) Machining and assembling facilities.

Goat, Fred, Co. Inc., The, 314 Dean street, Brooklyn, N. Y.
(a) Stamped, formed and drawn parts .001 to ⅛ in. thick, in steel, brass, nickel, monel, etc.
(b) Brackets, washers, covers, etc.
(c) Complete facilities.

Grammes, L. F., & Sons Inc., Allentown, Pa.
(a) Light brass, aluminum, steel, etc. stampings.
(b) Automotive, radio, clock and electrical parts.
(c) Complete facilities.

Gray, Peter, Corp., 286 Third street, Cambridge, Mass.
(a) Steel and nonferrous stampings to 3/16 in. thick x 5 sq. ft. on press work and 8 ft. long on brake work.
(b) Handles, guards, stop motions, meters, fans, covers, and textile machine parts.
(c) Complete assembling and some machining facilities.

Greenville Steel Car Co., Union street, Greenville, Pa.
(a) Heavy steel pressings to 1 in. in thickness and 50 ft. long.
(b) Railroad equipment.
(c) Assembling facilities up to 20 tons.

Gregory Mfg. Co., 2964 Whitney avenue, Mt. Carmel, Conn.
(a) Steel, brass, copper, etc., in shapes fitting within a 12 in. circle.
(b) Switches, spring tension washers and various other stampings.
(c) Complete facilities.

Greist Mfg. Co., The, New Haven, Conn.
(a) Small stampings, specializing on forming operations.
(b) Business machines, photographic, electrical, sewing machine, paper-cup making machine parts.
(c) Complete facilities.

Griffith-Hope Co., 6607 West Mitchell street, West Allis, Wis.
(a) Stampings of 30 gage to 10 gage drawn shapes, and shells up to 5 in. in depth.
(b) Paper-dispensing equipment, automobile stampings, etc.
(c) Assembling facilities.

H

Hagstrom Mfg. Co., 505 West Twenty-fifth street, Kansas City, Mo.
(a) Small stampings to 24 in. square, in all metals.
(b) Vending machine, tools, etc.
(c) Machining facilities.

Hardy Mfg. Corp., Corner of Broadway and Water street, Pendleton, Ind.
(a) All stampings, including deep drawing. No. 1 presses to toggle presses of 300-ton capacity.)
(b) Radio cabinets, radio parts, automobile parts and general stampings.
(c) Complete facilities.

Harvey Machine Co., 6200 Avalon boulevard, Los Angeles, Calif.
(a) All kinds of blanking, deep drawing up to 42 x 62 in. bed, in all metals.
(b) All types of machine parts.
(c) Complete facilities.

Hoosier Lamp & Stamping Corp., Evansville, Ind.
(a) Light gage, aluminum, stainless, monel, brass, etc.
(b) Interior refrigerator parts, etc.
(c) Alumiliting, plating, welding and complete assembling.

Hubbard, M. D., Spring Co., Pontiac, Mich.
(a) Small stampings in spring steels, hot and cold-rolled steel, brass, bronze, aluminum, monel and stainless steel.
(b) Expansion plugs, washers, flat springs and spring washers.
(c) Drilling, tapping and spot welding.

Hunter Pressed Steel Co., Lansdale, Pa.
(a) Various types, including deep drawn stampings, from smallest to ⅛-in. stock, 15 in. blank in all materials.
(b) All types of machine parts.
(c) Complete facilities.

I, J

Indiana Pressed Steel Co., Muncie, Ind.
(a) Medium and medium-large stampings in all metals.
(b) Refrigerator, automotive, radio, electrical, etc.
(c) Complete facilities.

Johnson Sheet Metal Works Corp., Richmond, Ind.
(a) Metal stampings to 1050-ton capacity.
(b) Truck and tractor parts, bus bodies, etc.
(c) Assembling facilities only.

K

Karp Metal Products Co. Inc., 129 Thirtieth street, Brooklyn, N. Y.
(a) Steel, brass, aluminum, monel, stainless steel, and other alloy stampings.
(b) Air conditioning, vending machines and storage cabinets, etc.
(c) Welding facilities.

Kees, F. D., Mfg. Co., 24 High street, Beatrice, Nebr.
(a) Light and medium stamped and formed parts and shallow drawings.
(b) All types of machine parts.
(c) Complete facilities.

Kingston Products Corp., Kokomo, Ind.
(a) Stampings to 24 in. square in brass, aluminum and steel.
(b) All types of machine parts.
(c) Complete facilities.

Klein Mfg. Co., Burlington, Ia.
(a) Steel and galvanized iron stampings.
(b) To customers' specifications.
(c) Complete facilities.

Klopping, A. C., Stamping Co., 1678 Norwood avenue, Toledo.
(a) Metal stampings in blank sizes 3/16-in. thick x 15 in. dia. and smaller.
(b) Auto parts, universal joint housings, chain covers, engine plates, spring hangers, etc.
(c) Machining and assembling facilities.

Koehler Mfg. Co. Inc., 295 Lincoln street, Marlboro, Mass.
(a) All types of metal stampings, blanked and drawn parts up to 6 in. dia. x 6 in. deep.
(b) Electric clocks, etc.
(c) Complete facilities.

Konigslow, Otto, The, Mfg. Co., 3610 Perkins avenue, Cleveland.
(a) Small and medium sized stampings in any metal.
(b) Spacing washers, stamped collars, brackets, and other parts.
(c) Milling, drilling, spot welding and assembling facilities.

L

Laminated Shim Co. Inc., 21-24 Forty-fourth avenue, Long Island City, N. Y.
(a) Small, flat, brass, steel, zinc, copper, etc.
(b) Shims.
(c) None.

Leake Stamping Co., 3180 Bellevue road, Toledo, O.
(a) Small and medium stampings.
(b) Automotive, tractor and wash machine stampings.
(c) Heat treating and assembling facilities.

Lees, John, Div., The Serrick Corp., Muncie, Ind.
(a) Small type production stampings in stainless steel, bronze, and cold-rolled steel.
(b) Various types of machine parts.
(c) Complete facilities.

Lewyt Metal Products Co., 112 Lafayette street, New York.
(a) Sheet metal stamping.
(b) Boxes, housings and cabinets.
(c) Machining and assembling facilities.

Lind, T. W., Co., 171 Eddy street, Providence, R. I.
(a) Stampings up to 5 in. in diameter.
(b) To customers' specifications.
(c) Complete facilities.

M

Manhattan Perforated Metal Co. Inc., 43-17 Thirty-seventh street, Long Island City, N. Y.
(a) Perforated metals of all kinds.
(b) To customers' specifications.
(c) None.

Metal Stamping & Mfg. Co., The, 16816 Waterloo road, Cleveland.
(a) All gages up to ¼ in., deep drawn stampings up to 6 in. deep, in steel and other metals.
(b) All types of machine parts.
(c) Complete assembling, spotwelding, riveting, machining and japanning facilities.

Midland Steel Products Co., The, West 106th and Madison avenue, Cleveland. (Detroit branch located at 6660 Mt. Elliott).
(a) Light and heavy stampings.
(b) Automobile frames, axle housings, tubes, etc.
(c) Complete facilities.

Milwaukee Metal Working Co., 3165 West Thirtieth street, Milwaukee.
(a) Open-belt press stampings.
(b) Automobile parts, etc.
(c) Complete facilities.

Milwaukee Stamping Co., 800 South Seventy-second street, Milwaukee.
(a) Steel, brass, bronze, etc., in thickness of ¼ in., max. draw 4 in., and up to 100 ton capacity.
(b) Belt guards, pulley flanges, legs, etc., or specially designed parts.
(c) Complete facilities.

Motors Metal Mfg. Co., 5936 Milford avenue, Detroit.
(a) Large and small stampings.
(b) Automotive.
(c) Machining and assembling facilities.

Mullins Mfg. Corp., Warren, O. (Another plant at Salem, O.).
(a) Light and heavy gage stampings, light gage deep drawn stampings from 20 to 16 gage in sizes up to 80 x 160, depth of draw up to 22 in.
(b) Washing machine tubs, steel evaporators, and automobile parts.
(c) None.

Murray Corp. of America, 7700 Russell street, Detroit.
(a) Light and heavy stampings of any type.
(b) Fenders, hoods, grilles and body stampings.
(c) None.

N

Nagel-Chase Mfg. Co., The, 2811-23 North Ashland street, Chicago.
(a) Pressed steel parts to 11 gage and about 20 in. dia.
(b) Pulleys for V-belts, washing machine castors, etc.
(c) Complete facilities.

Niles Steel Products Div., Republic Steel Corp., Niles, O.
(a) Pressed steel to ½ in. thick.
(b) Automotive, tractor, sweeper, washing machine, etc.
(c) Some machining and assembling facilities.

O, P

O'Hara Waltham Mfg. Co., 74 Rumford avenue, Waltham, Mass.
(a) Brass, copper and steel stampings in sizes to 3 x 3 in.
(b) Dials.
(c) Porcelain enameling, spot welding, etc.

Parish Pressed Steel Co., Robeson and Weiser streets, Reading, Pa.
(a) Ferrous and nonferrous metals from 2 in. to 40 ft. long from 1/32 to ⅜ in. thick.
(b) Housings and other parts.
(c) Complete facilities.

Parker Wire Goods Co., 149 Washington street, Worcester, Mass.
(a) Small stampings, in materials not to exceed .110 in. Diameter or square 10 in. max.
(b) To customers' specifications.
(c) Heat treating and assembling facilities.

Paul & Beekman, Div. Philadelphia Lawn Mower & Mfg. Co., 4250 Wissahickon avenue, Philadelphia.
(a) Special shapes in pressed stampings, all metals.
(b) Radio parts, washers, nut retainers vacuum cleaner, air conditioning and hosiery machinery parts, etc.
(c) Complete facilities.

Plymouth Stamped Metal Co., The, 330-334 Harding Way street, Galion, O.
(a) Small stampings made to order.
(b) To customers' specifications.
(c) Machining and assembling facilities.

Powell Pressed Steel Co., Hubbard, O.
(a) All types of stampings, large and small.
(b) Material handling equipment, automobile, refrigerator, washing machine parts, etc.
(c) Complete facilities.

Q, R

Quadriga Mfg. Co., The, 213 West Grand avenue, Chicago.
(a) Stampings of any material that can be worked in punch press up to 150-ton, 4 in. depth of draw.
(b) Washers, radio, automobile and any other machine parts.
(c) Complete facilities.

Raffel Mfg. Co., 4528-36 Fullerton avenue, Chicago.
(a) Metal stampings, deep drawing.
(b) Radio and refrigerator parts.
(c) None.

Raymond Mfg. Co., Div. Associated Spring Corp., Corry, Pa.
(a) Small stampings of steel, brass, phosphor bronze, monel, etc.
(b) Springs, etc.
(c) Heat treating facilities.

Redmond, A. G., Co., Flint, Mich.
(a) Small intricate stampings.
(b) Auto engine parts, valve spring locks and seats, oil gage rods, oil relief valves, etc.
(c) None.

Richmond Bros. Co., 173-177 Chestnut street, Newark, N. J.
(a) Stampings up to 1/16 x 12 in., in brass, tinplate, zinc and cold-rolled steel.
(b) To customers' specifications.
(c) Assembling facilities.

Rockwood Sprinkler Co., 52 Harlow street, Worcester, Mass.
(a) Medium-heavy deep drawings, stampings of brass, bronze and hot and cold-rolled steel, .020 to .375-in. thick, 1 to 12 in. blank dia.
(b) Machine handles, pipe unions, textile, electrical and automatic parts.
(c) Tapping, threading, squaring, sherardizing and parkerizing.

Rome-Turney Radiator Co., Canal street, Rome, N. Y.
(a) Copper, brass and steel stampings in sizes 15 x 30 x 6 in. deep.
(b) Automobile and refrigeration.

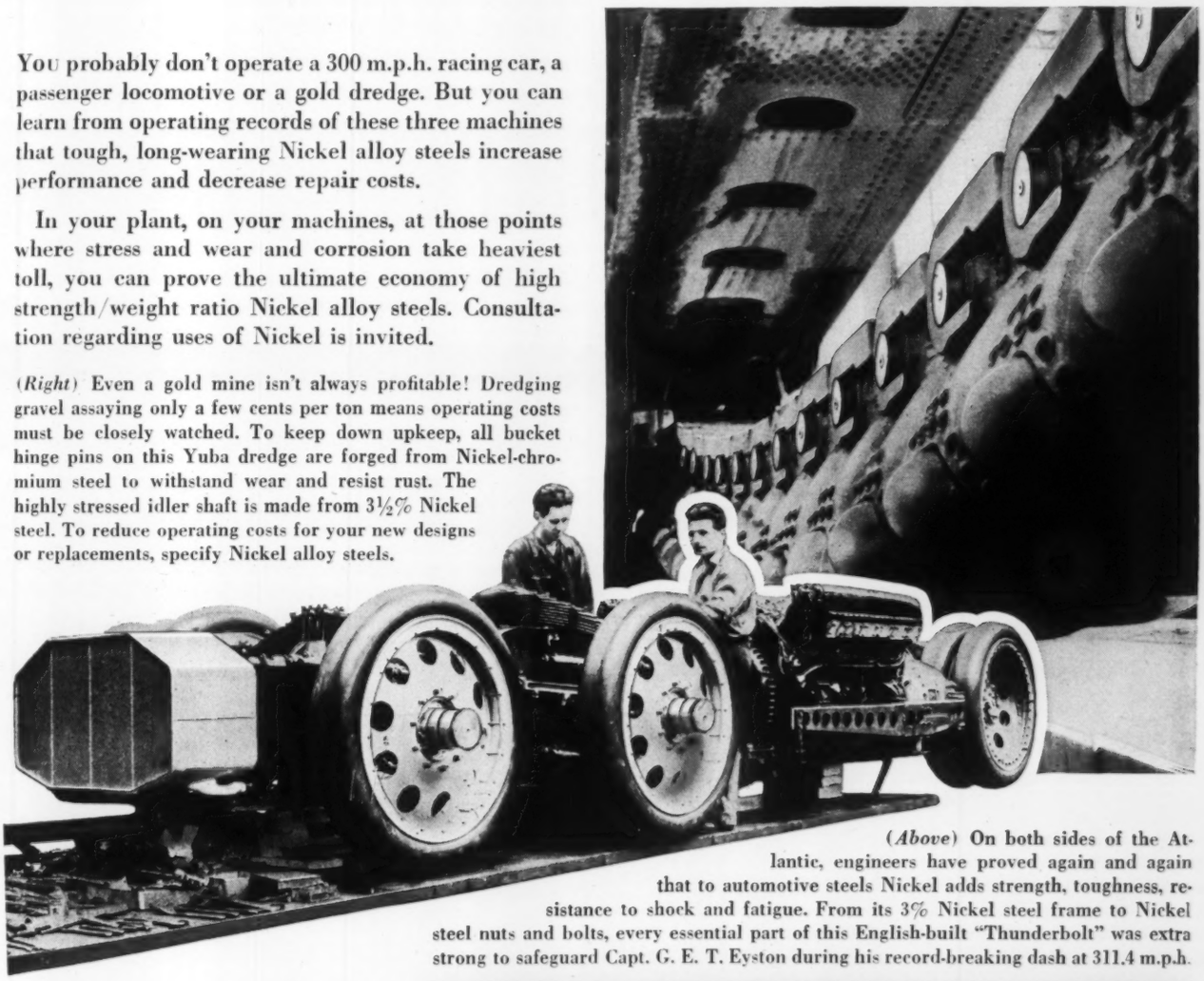
CAPTURING

hidden gold, split-seconds and maintenance records with NICKEL ALLOY STEELS

YOU probably don't operate a 300 m.p.h. racing car, a passenger locomotive or a gold dredge. But you can learn from operating records of these three machines that tough, long-wearing Nickel alloy steels increase performance and decrease repair costs.

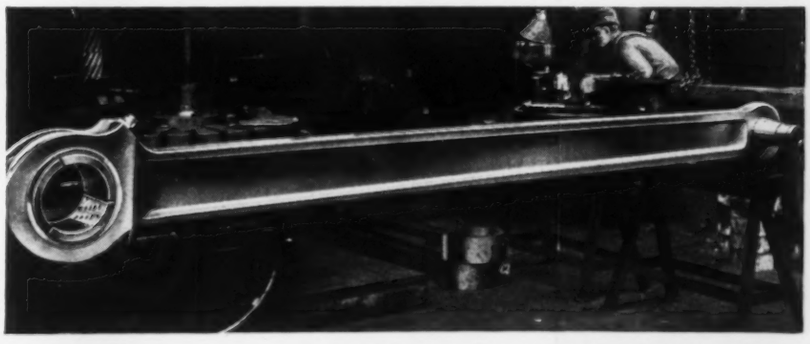
In your plant, on your machines, at those points where stress and wear and corrosion take heaviest toll, you can prove the ultimate economy of high strength/weight ratio Nickel alloy steels. Consultation regarding uses of Nickel is invited.

(Right) Even a gold mine isn't always profitable! Dredging gravel assaying only a few cents per ton means operating costs must be closely watched. To keep down upkeep, all bucket hinge pins on this Yuba dredge are forged from Nickel-chromium steel to withstand wear and resist rust. The highly stressed idler shaft is made from 3½% Nickel steel. To reduce operating costs for your new designs or replacements, specify Nickel alloy steels.



(Above) On both sides of the Atlantic, engineers have proved again and again that to automotive steels Nickel adds strength, toughness, resistance to shock and fatigue. From its 3% Nickel steel frame to Nickel steel nuts and bolts, every essential part of this English-built "Thunderbolt" was extra strong to safeguard Capt. G. E. T. Eyston during his record-breaking dash at 311.4 m.p.h.

(Right) Railroads have speeded up schedules and lowered operating costs by redesigning rotating and reciprocating engine parts and specifying Nickel alloy steels. New York Central tests proved that such rebalancing of mainline locomotives lessens rail pound at high speeds—and cuts track maintenance costs as much as 50%. You, too, may discover unexpected savings by using Nickel alloy steels.



THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.

(c) Gas and spot welding.

Rote, Robert J., Co., 1224-28 Fifth avenue, Rock Island, Ill.
(a) Sheet metal stampings workable on presses up to 600 tons, capacity 36 x 36 in.
(b) To customers' specifications.
(c) Complete facilities.

S

Schnorr, C. H., & Co., 643 Railroad street, Springdale, Pa.
(a) Steel, copper and aluminum stampings up to 30 in. diameter, 11 gage.
(b) Automotive, radio, railway and electrical parts.
(c) Complete facilities.

Scovill Mfg. Co., Waterbury, Conn.
(a) Brass, bronze, nickel silver, copper, steel, and other metal stampings, drawn shell and die pressings.
(b) To customers' specifications.
(c) Complete facilities.

Sessions, J. H., & Son, Riverside avenue, Bristol, Conn.
(a) Steel and brass, flat and formed stampings, 10 gage and lighter up to about 36 sq. in.
(b) Rivets, washers, burrs, etc.
(c) Assembling facilities.

Smith, H. A., Machine Co., Hamilton avenue and Somerset street, Hopewell, N. J.
(a) All metal to ⅛ in. thick and 6 in. dia.
(b) Recording devices, miscellaneous assemblies and meter parts.
(c) Machining and assembling facilities.

Standard Stamping Co. Inc., 530 West Lovett street, Charlotte, Mich.
(a) Small metal stampings.
(b) Rolled bushings, split steel spacer tubes, spring clips, etc.
(c) Cyanide furnace, lathes, screw machine, etc.

Standard Steel Sections Inc., 608 East 133rd street, New York.
(a) Formed and pressed metal up to ½ in. thick.
(b) To customers' specifications.
(c) None.

Stanley Gasket Mfg. Co., The, 3143 Emerald street, Philadelphia.
(a) Light metal stampings to 3/16 in. or ¼ in. thick.
(b) Gaskets, washers, etc.
(c) Machining and assembling facilities.

Stanley Works, Pressed Metal Div., New Britain, Conn.
(a) Small to medium-large stampings and deep drawn parts from steel or nonferrous metals, specializing in hinges.
(b) To customers' specifications.
(c) Complete facilities.

Swanson Tool & Machine Corp., 810-12 East Eighth street, Erie, Pa.
(a) Small and medium sized sheet metal stampings.
(b) Grill guards, leg cover plates, cable clamps, wringer parts, etc.
(c) Complete facilities.

T

Textile Shield Co., 1 Groton street, Lawrence, Mass.
(a) All kinds, up to 1/16 in. thick, specializing in deep drawn work.
(b) Radio and auto parts, ferrules, etc.
(c) Annealing facilities.

Thomas & Skinner Steel Products Co., 1123 East Twenty-third street, Indianapolis.
(a) Blanks, shallow-formed jobs in 16 gage or lighter, 8 in. square or smaller.
(b) Knitting machine parts, magnets and laminations.
(c) Heat treating.

Toledo Stamping & Mfg. Co., 99 Fearing boulevard, Toledo, O.
(a) Small, medium and large stampings.
(b) Automotive, tractor, washing machine and radio parts.
(c) Heat treating and assembling facilities.

Transue & Williams Steel Forging Corp., Alliance, O.
(a) Medium sized stampings, blanked, formed, pierced and drawn, from hot and cold rolled steel, stainless steel, aluminum and monel metal.
(b) All sizes and types of parts.
(c) Welding, brazing, punching and riveting.

Triangle Mfg. Co., 388-92 Division street, Oshkosh, Wis.
(a) Steel, brass and aluminum stampings.
(b) Automotive, etc.
(c) Machining and electroplating facilities.

Triangle Tool Die & Stamping Co., 4822 Payne avenue, Cleveland.
(a) Blanking, forming, drawing, etc., all metals, to 75-ton pressure capacity.
(b) Air conditioning, electrical, motor commutators, fans, etc.
(c) Machining and assembling facilities.

Truscon Steel Co., Pressed Steel Division, 6100 Truscon avenue, Cleveland.
(a) From 20 gage to heavier gage stampings.
(b) Refrigerator, automotive, housings, washing machine, etc.
(c) None.

V, W

Victor Mfg. & Gasket Co., 5750 West Roosevelt road, Chicago.
(a) Max. 12 in. x 60 in. shallow draw, light gage, all metals.
(b) Gaskets for automotive, marine, diesel, refrigerator, etc. fields.
(c) Complete facilities.

Wagner Specialty Co., P. O. Box 404, Burlington, Wis.
(a) Blanking, forming up to 10 gage material in steel, brass, copper, stainless steel, aluminum.
(b) Washers, rings, perforated plates, pump parts, handles, etc.
(c) Machining and assembling facilities.

Whitehead Stamping Co., 1661 West Lafayette road, Detroit.
(a) Light, medium and heavy parts, blanks from .002 in. to ⅜ in. thick, 1/16 in. to 18 in. diameter.
(b) Special washers, cups, collars, retainers, shims, etc.
(c) Complete facilities.

Williams, H. E., Products Co., 100-108 South Main street, Carthage, Mo.
(a) Light stampings, steel and nonferrous metals, press size to 50 tons capacity.
(b) Automotive.
(c) Turret lathes, spot welders, plating, etc.

Williamsport Die & Machine Co., 618 Day street, Williamsport, Pa.
(a) Medium and lightweight stampings of sheet or bar stock, other than wire forming.
(b) To customers' specifications.
(c) Machining and some heat treating facilities.

Woodworth Specialties Co., 121-125 Montgomery street, Binghamton, N. Y.
(a) Small stampings from any metal. (Presses up to 25-ton capacity).
(b) To customers' specifications.
(c) Complete facilities.

Worcester Pressed Steel Co., 100 Barber avenue, Worcester, Mass.
(a) Pressed metal stampings from ½ in. to 4 ft. dia., in lengths up to 7 ft., using material from .0002 to ½ in. thick.
(b) Automotive, airplane, oil burner vacuum cleaner, transmission parts, etc.
(c) Complete facilities.

Wrought Washer Mfg. Co., 2102 South Bay street, Milwaukee.
(a) Stampings, blanking, forming, drawing, extruding, in all ferrous and nonferrous metals. (Presses 300 ton capacity; material up to 1¼ in. thick.)
(b) Washers, expansion plugs, automotive, etc.
(c) Complete facilities.

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WAREHOUSES IN ALL PRINCIPAL CITIES

Forgings Producers

Reference letters beneath addresses of companies refer to: (a) Types, materials and sizes of forgings; (b) Names of forged machine parts customarily produced; and (c) Machining or heat treating facilities.

A

Alliance Drop Forging Co., P. O. Box 495, Alliance, O.
(a) Drop forgings.
(b) To customers' specifications.
(c) Information not available.

American Brass Co., Waterbury, Conn.
(a) Hot-pressed copper, brass, bronze, nickel, silver, and special copper alloys in small sizes and shapes.
(b) To customers' specifications.
(c) None.

American Hollow Boring Co., Erie, Pa.
(a) Hollow-bored forgings.
(b) Piston rods, clutch shafts, hydraulic cylinders, etc.
(c) Complete facilities.

American Locomotive Co., Schenectady, N. Y.
(a) Forgings of 10 tons maximum weight and not over 17 ft. in length.
(b) Axles, crank pins, connecting rods, etc.
(c) Complete facilities.

Anderson-Shumaker Co., 824 South Central avenue, Chicago.
(a) All type forgings of high speed alloy carbon and open-hearth machinery steels.
(b) Shafts, rings, disks and special shapes.
(c) Complete facilities.

Atlas Drop Forge Co., 209 West Mount Hope avenue, Lansing, Mich.
(a) All sizes and shapes, any material, from few ounces to four or five hundred pounds.
(b) Farm implements, tractors, railroad, aviation, automotive, etc.
(c) Complete heat treating facilities.

Atwater Mfg. Co., Plantsville, Conn.
(a) Drop and upset forgings of steel and brass.
(b) To customers' specifications.
(c) Information not available.

B

Bay City Forge Co., Erie, Pa.
(a) Flat die forgings up to 7000 lbs.
(b) Crankshafts, connecting rods, rolls, pinions, etc.
(c) Complete facilities.

Bayonne Bolt Corp., Bayonne, N. J.
(a) Heavy bolt type and upset rod forgings up to 3 in. dia.
(b) Bolts and similar machine parts.
(c) Complete facilities.

Benton Harbor Malleable Industries, Benton Harbor, Mich.
(a) Drop hammer steel forgings up to 80 pounds.
(b) All types of parts.
(c) Heat treating facilities.

Bethlehem Steel Co., Bethlehem, Pa.
(a) Open die forgings up to 225,000 lbs. in all grades of carbon and alloy steels—solid and hollow. Drop forgings from 1 lb. to 350 lbs. Also upset forgings.
(b) Shafts, rotors, rolls, gears and other press and hammer forgings.
(c) Complete facilities.

Billings & Spencer Co., The, 1 Laurel street, Hartford, Conn.
(a) All types in brass, bronze, stainless steel, alloys, straight carbon steel, monel metal and tool steel; up to 100 lbs.
(b) Airplane, automobile, machine tool parts, gas and diesel engine, conveyor, mining machinery, typewriter parts, etc.
(c) Complete facilities.

Blakeslee Forging Co., The, Plantsville, Conn.
(a) Light drop forgings to 25 lbs., all grades steel, brass, bronze and copper.
(b) To customers' specifications.
(c) Machining; normalizing and annealing.

Bonney Forge & Tool Works, Allentown, Pa.
(a) Drop forging from 1 ounce to 8 lbs. of any grade steel, alloy or carbon; also small upset forgings.
(b) Lathe dogs, tool posts and wedges, and machine handles.
(c) Complete facilities.

Bradley, C. C., & Son Inc., 432 North Franklin street, Syracuse, N. Y. (Affiliated with Irving Forgings Corp., Syracuse, N. Y.)
(a) Small drop forgings up to 5 lbs., hammer type forgings in all sizes, small upset forgings 1 in. and under; flat die forgings. Materials forged: carbon, alloy, tool steel, stainless, monel, nitralloy, bronze, aluminum.
(b) Weldless rings, spindles, gear blanks, disks, blocks, valve and pump trim, etc.
(c) Complete facilities.

Brewer-Titchener Corp., 111 Port Watson street, Cortland, N. Y.
(a) Hammer forgings 1000 to 4000 lbs.; upset forgings ¾ to 4 in.; and any forgings within the range of 1 ounce to 15 lbs.
(b) Automotive parts.
(c) Complete facilities.

Brill, The J. G., Co., Sixty-third street and Woodland avenue, Philadelphia.
(a) Drop hammer forgings up to 100 lbs.; hydraulic press forgings to 250 lbs.; upset forgings to 5 inch machine capacity.
(b) Truck, automotive, tool, railroad, and gas engine parts.
(c) Complete facilities.

Buckeye Forging Co., 10001 Harvard avenue, Cleveland.
(a) Small forgings of carbon and alloy steels, stainless steels, brass and copper.
(b) Automotive, tractor, tank, boiler and steel drums.
(c) Machining facilities.

C

Canton Drop Forging & Mfg. Co., The, Canton, O.
(a) Special forgings 2000 lbs. to 12,000 lbs. steam hammer ratings, and upset items up to and including 7½ in. machine capacity.
(b) Gears, connecting rods, axle shafts and all aircraft engine requirements.
(c) Complete facilities.

Cape Ann Tool Co., 146 Granite street, Pigeon Cove, Mass.
(a) All types and sizes of drop and upset forgings from ferrous and nonferrous metals.
(b) To customers' specifications.
(c) Heat treating facilities.

Carnegie-Illinois Steel Corp., 434 Fifth avenue, Pittsburgh.
(a) All type forgings produced with open dies, in all types of steel. Rounds—body diameter 68 in., max. collar diameter, 90 in., max. weight 220,000 lbs. Rectangular—up to 30 in. max. thickness, 150 in. max. width, with max. weight of 220,000 lbs. Hollow rounds—max. outside diameter 140 in.
(b) Marine, axles, bars, bridge pins, crankshafts, hexagon shafts, propeller shafts, rotors, locomotive, back up rolls, sleeves, pinions, reduction gears, spindles, mill housings, etc.
(c) Complete facilities.

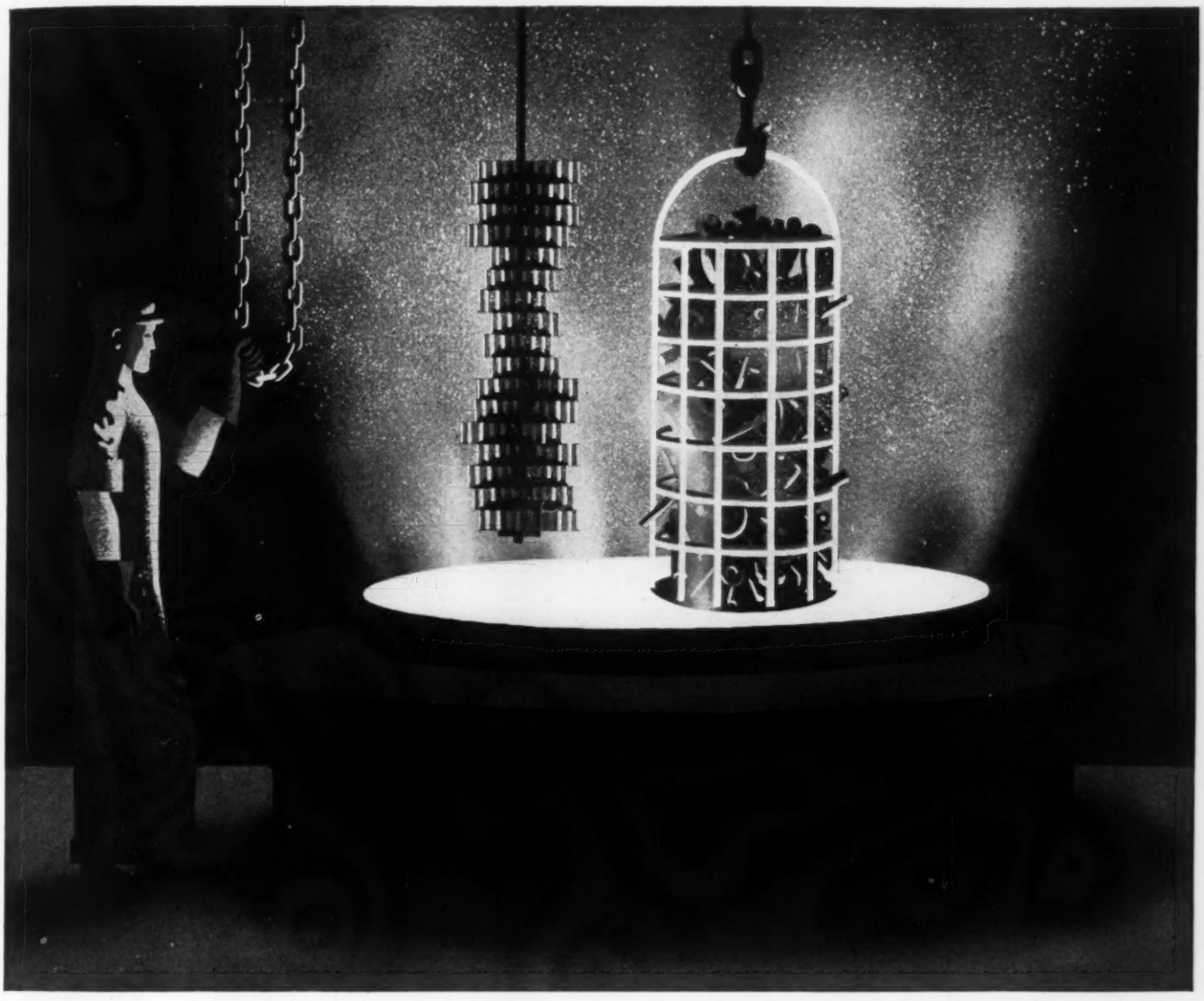
Carpenter Steel Co., The, 120 Bern street, Reading, Pa.
(a) Simple forgings made on flat dies in all S.A.E., stainless and tool steels up to 3000 lbs.
(b) Rings, disks, blocks, simple shafts, axles, etc.
(c) All heat treating facilities; minimum of machine work.

Champion Machine & Forging Co., 3695 East Seventy-eighth street, Cleveland.
(a) All type steel forgings to 800 lbs.
(b) To customers' specifications.
(c) Complete facilities.

Chase Brass & Copper Co. Inc., 236 Grand street, Waterbury, Conn.
(a) Light forgings in commercial brass, naval and Chamet bronze, copper and Olympic bronze, up to 8 lbs.
(b) Automotive, aircraft, refrigeration parts, air valves, etc.
(c) Annealing and machining facilities.

Clapp, E. D., Mfg. Co., 305 Genesee street, Auburn, N. Y.
(a) Drop forgings.
(b) To customers' specifications.
(c) Complete facilities.

Cleveland Hardware & Forging Co., 3270 East Seventy-ninth street, Cleveland.
(a) Drop and upset forgings in steel and brass.
(b) To customers' specifications.



WHERE SIMPLIFICATION SPELLS E-C-O-N-O-M-Y

From one type of steel—Chrome-Moly (S.A.E. 4140)—a certain manufacturer turns out literally hundreds of different parts used in three types of machine tools built in a wide range of sizes and ratings. Included are gears, shafts, spindles and pins with a variety of requirements. Previously, four different kinds of more expensive steel had been used for the same group of parts.

By adopting Chrome-Moly steel for all these parts, this manufacturer's stock inventory has been simplified, carry-over material investment greatly reduced. Heat treating is also simplified, since different parts are now heat treated in the same batch irrespective of shapes and sizes.

Such simplification speeds fabricating processes and cuts production costs. Other economies and features of Moly steels are described in our technical book, ***"Molybdenum in Steel,"*** which is free to engineers and production executives. Climax Molybdenum Co., 500 Fifth Ave., New York.

PRODUCERS OF FERRO-MOLYBDENUM, CALCIUM MOLYBDATE AND MOLYBDENUM TRIOXIDE

Climax Mo-lyb-den-um Company

MOLY

(c) Complete facilities.

Clifford-Jacobs Forging Co., Box 264, Champaign, Ill.
(a) Drop forgings.
(b) Steel flanges, center plates, wedges, hubs, gears, conn. rods.
(c) Information not available.

Columbus Bolt Works Co., 291 Marconi boulevard, Columbus, O.
(a) All types of forgings to 5 lbs., of carbon and alloy steels.
(b) Air conditioning, agricultural, automotive, conveying, electrical, mining, refrigeration and textile machinery parts.
(c) Complete facilities.

Columbus Forge & Iron Co., 977 Perry street, Columbus, O.
(a) Drop forgings.
(b) To customers' specifications.
(c) Information not available.

Conley Frog & Switch Co., P. O. Box 3147, Mallory Station, Memphis, Tenn.
(a) 3½ in. and 1 in. forgings.
(b) Railroad switches, frogs, crossings, etc.
(c) Heat treating facilities.

Cornell Forge Co., 1659 West Seventy-fourth street, Chicago.
(a) All type drop forgings, from fraction of an ounce to 15 lbs.; carbon steel, alloy, monel, stainless steel.
(b) Cams, crankshafts, pins, gears, hubs, valves, connecting rods, etc.
(c) Heat treating, annealing, sandblasting and some machining.

Crucible Steel Co. of America, 405 Lexington avenue, New York.
(a) All types of forgings in carbon and alloy grades up to 40 tons max. weight.
(b) Crankshafts, propeller shafts, piston rods, rams, gun forgings, etc.
(c) Complete facilities.

D

Davenport Besler Corp. 2305 Rockingham road, Davenport, Ia.
(a) Drop forgings and open steam hammer forgings.
(b) Crankshafts, connecting rods, levers and railway equipment.
(c) Complete facilities.

Delaware Alloy Forge Co., 2300 East Tioga street, Philadelphia.
(a) Flat die steam hammer work in stainless steel, tool steel, nitralloy, monel metal, bronze and other alloys from 1 lb. to 5000 lbs.
(b) Seat rings for large valves, knitting machine cylinders, paper machinery shafts, and gears.
(c) Complete facilities.

Dow Chemical Co., The, Midland, Mich.
(a) Magnesium alloy forgings.
(b) To customers' specifications.
(c) Heat treating facilities.

Drop Dies & Forgings Co., 3092 East Sixty-third street, Cleveland.
(a) Drop forgings up to 25 lbs.
(b) To customers' specifications.
(c) None.

Duff-Norton Mfg. Co., P. O. Box 1889, Pittsburgh.
(a) Standard and special forgings, not exceeding 100 lbs.
(b) Valves, connecting rods, etc.
(c) Complete facilities.

Dyson, Jos., & Sons Inc., 5125 St. Clair avenue, Cleveland.
(a) Flat die forgings in all grades of open-hearth and alloy steels in any size or type.
(b) Shafts, crankshafts, gears, nuts, sleeves and forks.
(c) Complete facilities.

E, F

Ellwood City Forge Co., Box 589, Ellwood City, Pa.
(a) Steel forgings from 25 to 35,000 lbs.
(b) Crankshafts, aircraft, automobile, gas, steam, or diesel engines.
(c) Complete facilities.

Federal Drop Forge Co., 2200 South Washington avenue, Lansing, Mich.
(a) Drop forgings up to 25 lbs.
(b) To customers' specifications.
(c) Information not available.

Finkl, A., & Sons Co., 2011 North Southport avenue, Chicago.
(a) Hammer and press forgings in ordinary steels from 5 to 50,000 lbs.
(b) Shafts, rolls, rings, gear and pinion blanks, etc.
(c) Complete facilities.

Forgings & Stampings Inc., Twenty-third avenue and Seventh street, Rockford, Ill.
(a) Drop forgings.
(b) To customers' specifications.
(c) Information not available.

G, H

General Metals Corp., 5700 South Boyle avenue, Los Angeles.
(a) Drop forgings.
(b) To customers' specifications.
(c) Heat treating facilities.

Globe Forge & Foundries Inc., 101 Greenway avenue, Syracuse, N. Y.
(a) Drop and upset forgings in carbon and alloys from few ounces to 125 lbs.
(b) Differential, transmission gears.
(c) Complete facilities.

Hammond & Irving Inc., 254 North street, Auburn, N. Y.
(a) Steam forgings in alloy and tool steels, stainless, nitralloy and monel metals, up to 1200 lbs.
(b) Weldless rings, gear blanks, shafts, hammered bars, etc.
(c) Complete facilities.

Harley Co., Page boulevard, Springfield, Mass.
(a) Drop hammer forgings to 20 lbs., not over 18 in. long.
(b) Auto parts, surgical instruments, and bicycle parts.
(c) Complete facilities.

Harris-Thomas Drop Forge Co., 126 Harshman street, Dayton, O.
(a) Drop forgings.
(b) To customers' specifications.
(c) Information not available.

Hartford Drop Forge Corp., 846 Windsor street, Hartford, Conn.
(a) Die and drop forgings in steel, copper, brass, monel up to 7 lbs.
(b) Gears, levers, loom parts, and any part to customers' specifications.
(c) None.

Harvey Spring & Forging Co., Seventh street and Racine, Wis.
(a) Drop forgings.
(b) To customers' specifications.
(c) Information not available.

Herbrand Corp., Fremont, O.
(a) Drop forgings.
(b) Auto forgings, etc.
(c) Heat treating facilities.

Huron Forge & Machine Co., 9043 Alpine avenue, Detroit.
(a) Drop forgings.
(b) To customers' specifications.
(c) Information not available.

I, J, K

Indiana Forge & Machine Co., East Chicago, Ind.
(a) Drop forgings up to 12 lbs.
(b) Clutch hubs, etc.
(c) Complete facilities.

Indianapolis Drop Forging Co., 1300 Madison avenue, Indianapolis
(a) Drop and steam hammer forgings in carbon and alloy steel up to 400 lbs.
(b) Gears and pinions.
(c) Complete heat treating facilities.

International Nickel Co. Inc., 67 Wall street, New York.
(a) Monel, K monel, nickel, and Inconel—max. slabs 20 x 30 x 10,000 lbs. or 25 in. dia. x 11,000 lbs.
(b) Miscellaneous parts.
(c) Complete facilities.

Interstate Drop Forge Co., 4051 North Twenty-seventh street, Milwaukee.
(a) Drop and upset forgings.
(b) Levers, gears, segments, hydraulic fittings, connecting rods, crankshafts, etc.
(c) Heat treating facilities.

Isaacson Iron Works, 2917 East Marginal Way, Seattle, Wash.
(a) All type forgings in steels and alloys in any size.
(b) Road machinery parts, crankshafts and cutter heads.
(c) Complete facilities.

Johnston & Jennings Co., 877 Addison road, Cleveland.
(a) Flat die forgings in plain carbon and alloy steels, 1 to 5 tons.
(b) Spindles, solid and hollow bored, rings, blanks, arbors, shafts, gears, etc.
(c) Complete facilities.

Jones & Laughlin Steel Corp., Third and Ross street, Pittsburgh.
(a) Smooth, rough turned and finished forgings of any size.
(b) To customers' specifications.
(c) Annealing, normalizing and heat treating.

Kortick Mfg. Co., 345 First street, San Francisco.
(a) Drop forgings.
(b) Bolts, nuts, washers, etc.
(c) Information not available.

L

Ladish Drop Forge Co., Packard avenue, Cudahy, Wis.
(a) Drop forgings.
(b) To customers' specifications.
(c) Heat treating facilities.

Lakeview Forge & Clevis Co., Pittsburgh avenue, Erie, Pa.
(a) Drop forgings up to 10 lbs. in alloy or carbon steel.
(b) To customers' specifications.
(c) Heat treating facilities.

Lamson & Sessions Co., The, Cleveland, Chicago and Birmingham, Ala.
(a) Hot and cold forging of any metal or alloy, ½ to 2½ tons.
(b) Bolts, nuts, cotters, cap screws and special hot and cold upset products.
(c) Complete facilities.

Lansdowne Steel & Iron Co., Morton, Pa.
(a) Hollow forgings.
(b) To customers' specifications.
(c) Complete facilities.

Larson, Charles E., & Sons Inc., 2745 North Keeler avenue, Chicago.
(a) Iron and steel, straight hammer forgings, from 1 to 6000 lbs.
(b) Bars, blocks, disks, rings and special shapes.
(c) Complete facilities.

Leard, William, Co. Inc., New Brighton, Pa.
(a) Hammered and hydraulic pressed steel forgings up to 25,000 lbs.
(b) Crankshafts, connecting rods and other type forged steel shafts.
(c) Complete facilities.

M

Main Steel Inc., South Portland, Me.
(a) Drop forgings from carbon steel, special alloy steels, bronze or stainless steel.
(b) Nut ring bolts, swing links, sockets, turnbuckles, connecting links, etc.
(c) Machining and heat treating facilities.

CHEMICALLY RESISTANT SILENT GEARS

FORMICA gears are silent and flexible and very inert chemically. The latter quality explains why they are chosen for the drive on plating barrels and similar equipment where very destructive solutions are encountered. In most applications where chemicals are encountered, these gears will prove to be more durable.

Good gear cutters in all parts of the country carry Formica gear material in stock and can cut one or many gears promptly for replacement purposes. Try one the next time you need a gear.

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4648 Spring Grove Avenue Cincinnati, Ohio.

FORMICA

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Harry A. Moore,
Bangor, Me.
The Union Gear & Mach. Co.
Boston, Mass.
Chicago Rawhide Mfg. Co.
Chicago, Ill.
Perfection Gear Company
Chicago, Ill.
Gear Specialties, Inc.
Chicago, Ill.
Merkle-Korff Gear Co.
Chicago, Ill.
Chicago Gear Works
Chicago, Ill.
Foote Gear Works
Cicero, Ill.
The Cincinnati Gear Co.
Cincinnati, O.
Clarksville Foundry &
Machine Co.
Clarksville, Tenn.
The Horsburgh & Scott Co.
Cleveland, O.
The Stahl Gear & Machine Co.
Cleveland, O.
The Master Electric Co.
Dayton, O.
Boal Foundry & Machine Co.
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C. A. Lawton Company
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Hoell Machine Co.
Green Bay, Wis.
Hartford Special Mchny. Co.
Hartford, Conn.
S O S Machine Co.
Kansas City, Mo.
Beatty Machine Works
Keokuk, Ia.
The Generating Gear Co.
Milwaukee, Wis.
Badger State Gear Co.
Milwaukee, Wis.
Precision Machine Co.
Milwaukee, Wis.
E. A. Pynch Co.
Minneapolis, Minn.
Joaquin Alemany Lopez
Havana, Cuba
Kennedy & Bowder
Nashville, Tenn.
Natisch Gear Works
Brooklyn, N. Y.
New Jersey Gear & Mfg. Co.
Newark, N. J.
Prager, Inc.
New Orleans, La.
J. Morrison Gilmour
New York City
Sier-Bath, Inc.
New York City, N. Y.
Mid-State Electrical Engineering Co.
Osceola Mills, Pa.
Puritan Machine Co.
Omaha, Neb.
E. M. Smith Machine Co.
Peoria, Ill.
The Eagle Gear & Mch. Co.
Philadelphia, Pa.
Rodney Davis and Sons
Philadelphia, Pa.
The Pittsburgh Machine &
Supply Co., Pittsburgh, Pa.
Perkins Machine & Gear Co.
Springfield, Mass.
Winfield H. Smith, Inc.
Springville, N. Y.
Alling Lander Company
Sodus, N. Y.
Charles E. Crofoot Gear
Corp'n, South Easton, Mass.
Arlington Machine Co.
St. Paul, Minn.
Farwell Mfg. Co.
Toledo, O.
Diefendorf Gear Corp.
Syracuse, N. Y.
Batson Cook Co.
West Point, Ga.
Worcester Gear Works
Worcester, Mass.
Massachusetts Gear & Tool
Co., Woburn, Mass.

Melling Forging Co., 1401 North Case street, Lansing, Mich.
(a) Small drop forgings up to 10 lbs. in alloy and carbon steels.
(b) Automotive, airplane, agricultural implement and small tool parts.
(c) Complete facilities.

Mesta Machine Co., Box 1466, Pittsburgh.
(a) Very large steel and alloy steel forgings.
(b) Shafts, pinions, rolls, etc.
(c) Complete facilities.

Midvale Co., The, Nicetown, Philadelphia.
(a) Press or hammer forgings, solid or hollow, in carbon or alloy steel.
(b) All types of parts.
(c) Complete facilities.

Mitchell Steel Co., The, Stockyards Station, Cincinnati.
(a) Steam hammer forgings in plain carbon, alloy, and stainless steel.
(b) All types of machine parts, railroad, marine, etc.
(c) Complete facilities.

Modern Die & Drop Forge Co., 2600 West 139th street, Blue Island, Ill.
(a) Drop forgings.
(b) To customers' specifications.
(c) Information not available.

Mondie Forge Co. Inc., 10300 Berea road, Cleveland.
(a) Drop forgings up to 75 lbs., upset forgings to 4 in., also gear blanks.
(b) To customers' specifications.
(c) Machining facilities.

Moore Drop Forging Co., 36 Walter street, Springfield, Mass.
(a) Drop and upset forgings.
(b) To customers' specifications.
(c) Information not available.

Motor State Forging Co., 3564 Toledo, Detroit.
(a) Forgings in carbon and alloy steels, from ¼ to 3 lbs.
(b) Miscellaneous auto parts.
(c) Normalizing only.

Mueller Brass Co., 1925 Lapeer avenue, Port Huron, Mich.
(a) All types of forging in brass and aluminum copper, ½ oz. to 70 lbs.
(b) Automotive, mechanical refrigeration, air conditioning, locomotive, etc.
(c) Complete facilities.

N

National Lock Washer Co., 40 Hermon street, Newark, N. J.
(a) Drop forgings.
(b) Spring washer, etc.
(c) Heat treating facilities.

Norris Bros. Inc., Robinson, Ill.
(a) Upset, bulldozer and small hammer iron and steel forgings in sizes of 2 in. square, round or equivalent.
(b) Turnbuckle hooks and eyes, hoist hooks and oil well supplies.
(c) Complete facilities.

O

Octigan Forge Co., 2824 S. Lowe avenue, Chicago.
(a) Drop forgings.
(b) To customers' specifications.
(c) Heat treating facilities.

Ohio Forge & Machine Corp., 3010 Woodhill road, Cleveland.
(a) Drop, upset and flat hammer steel forgings in all sizes.
(b) Gear blanks and other machine parts.
(c) Complete heat treating, machining for gear shafts only.

Oliver Iron & Steel Corp., North East Corner South Tenth and Muriel streets, Pittsburgh.
(a) Small forgings in iron, steel and alloys in sizes of 8 in., and weight of 5 lbs.
(b) Bolts, nuts, rivets, etc.
(c) Complete facilities.

Owensboro Forging Co., Owensboro, Ky.
(a) Drop forgings.
(b) To customers' specifications.
(c) Heat treating facilities.

P

Park City Forge Co., 1410 Stratford avenue, Stratford, Conn.
(a) Heavy die, press and hydraulic forgings in alloys and steel up to 5000 lbs.
(b) Rings, shafts, bars, blocks, etc.
(c) Complete facilities.

Park Drop Forge Co., The, 730 East Seventy-ninth street, Cleveland.
(a) All types of drop steel forgings up to 4000 lbs. each.
(b) Crankshafts, connecting rods, camshafts, axles, gears, etc.
(c) Complete machining, heat treating.

Pettibone Mulliken Co., 4720 West Division street, Chicago.
(a) Drop forgings.
(b) To customers' specifications.
(c) Heat treating facilities.

Phoenix Mfg. Co., Catasauqua, Pa.
(a) Drop forgings.
(b) To customers' specifications.
(c) Heat treating facilities.

Pittsburgh Trolley & Forge Co., 117 Water street, Pittsburgh.
(a) All types forgings in carbon and alloy steels, up to 2000 lbs.
(b) Spindles, shafts, gears, rings, etc.
(c) Complete facilities.

Pittsburgh Forgings Co., Coraopolis, Pa.
(a) Drop and upset forgings, from 1 oz. to 350 lbs.
(b) Automotive, tractor, farm implement, railroad car, machine tool parts, and gear blanks.
(c) Complete heat treating.

Pittsburgh Forgings Co., Riverside Forge & Machine Co. division, Jackson, Mich.
(a) Round steel forgings up to 12 in. dia., ⅜ in. thick, 4 to 50 lbs.
(b) Gears, pulleys, flanges, wheels, hubs, etc.
(c) Complete facilities.

Poor & Co., Canton Forge & Axle Works, 2027 Dueber avenue southwest, Canton, O.
(a) Drop die and upset forgings in carbon and alloy steels, from 1 to 350 lbs.
(b) Spindles, levers, gears, etc.
(c) Complete facilities.

Porter Forge & Furnaces Inc., 6 Ashland street, Everett, Mass.
(a) Drop forgings of standard and special steels and metals.
(b) To customers' specifications.
(c) Heat treating facilities.

R

Rockford Drop Forge Co., 1033 Ninth street, Rockford, Ill.
(a) Drop forgings.
(b) Automotive and industrial clutches, etc.
(c) Information not available.

Rome Mfg. Co. Div., Revere Copper & Brass Inc., Railroad street, Rome, N. Y.
(a) Hot pressed forgings in brass, copper and related alloys.
(b) To customers' specifications.
(c) Complete facilities.

S

St. Pierre Chain Corp., 50 Frank street, Worcester, Mass.
(a) All types of forgings from alloys, soft steels, etc., from 1 oz. to 50 lbs.
(b) Automobile, airplane and other machine parts.
(c) Complete facilities.

Scovill Mfg. Co., Waterbury, Conn.
(a) Made-to-order forgings from brass, bronze, copper, nickel silver and aluminum in all sizes.
(b) To customers' specifications.
(c) Complete facilities.

Shuler Axle Co. Inc., 2901 South Second street, Louisville, Ky.
(a) All type forgings in carbon, alloy steel, and brass, from 1 to 300 lbs.
(b) Automotive and trailer axles.
(c) Complete facilities.

Spicer Mfg. Corp., Toledo, O.
(a) Drop, upset and pressure forgings in plain and alloy steels, up to 30 lbs.
(b) Universal joint yokes, forks, gears, shafts, etc.
(c) Complete facilities.

Standard Steel Works Co., Burnham, Mifflin Co., Pa.
(a) Forgings in carbon and alloys to 42 ft. in length and 60,000 lbs. in weight.
(b) Piston rods, columns, spindles, etc.
(c) Complete facilities.

Steel Improvement & Forge Co., 960 Addison road, Cleveland.
(a) Drop hammer, upset and press forging.
(b) Machine tool, aircraft, automotive, truck and tractor, marine and coal industries.
(c) Complete facilities.

Storms Drop Forging Co., P. O. Box 1688, Springfield, Mass.
(a) Drop forgings, from a fraction of an ounce to 50 lbs., of all grades of forgeable materials; also hot pressed brass forgings.
(b) Parts for textile machinery, etc.
(c) Complete heat treating.

Struthers Wells Titusville Corp., Titusville Forge Div., 605 East Spring street, Titusville, Pa.
(a) All type forgings in carbon and alloy steels, 40 lbs. to 40 tons.
(b) Crankshafts, hollow-bored forged parts up to 75 ft. long, and all types of hammered steel forgings.
(c) Complete facilities.

T

Transue & Williams Steel Forging Corp., Alliance, O.
(a) All sizes and types of drop forgings from 1 oz. to 1000 lbs.
(b) Various sizes and types of connecting rods, crankshafts and gears.
(c) Complete heat treating.

U, V, W

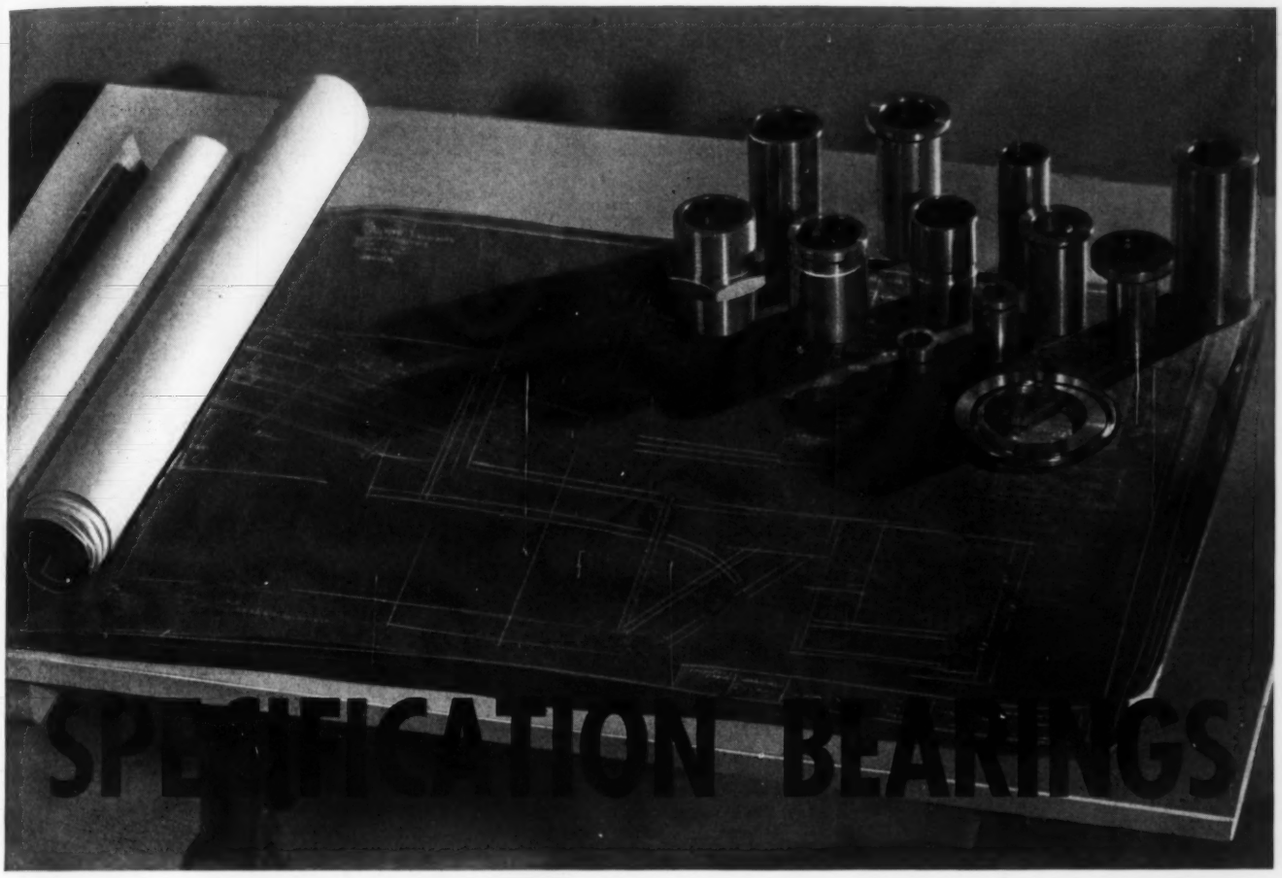
Union Forging Co., Endicott, N. Y.
(a) Drop and press forgings.
(b) Automotive parts.
(c) Heat treating facilities.

Unit Drop Forge Corp. 1903 South Sixty-second street, West Allis, Wis.
(a) Drop forgings.
(b) To customers' specifications.
(c) Heat treating facilities.

Vulcan Steam Forging Co., 223-257 Rano street, Buffalo, N. Y.
(a) Open die forgings of carbon, alloy, tool and stainless steels, and nonferrous metals.
(b) Gear blanks, crankshafts, piston rods, levers, spindles, rolls, weldless rings, shaped work.
(c) Complete facilities.

Williams, J. H., & Co., 400 Vulcan street, Buffalo, N. Y.
(a) Drop forgings in steel and nonferrous metal from ½ oz. to 350 lbs.
(b) Structural forged parts, gears, levers, cams, cranks, etc., for machine tools, gas engines, compressors, aircraft, etc.
(c) Complete facilities.

Wyman-Gordon Co., Worcester, Mass., and Harvey, Ill.
(a) Drop hammer, upset and press forgings in steel and aluminum from 10 to 500 lbs.
(b) Automotive and aviation.
(c) Heat treating facilities.



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Die Castings Producers

Reference letters beneath addresses of companies refer to: (a) Types, materials and sizes of die castings; (b) Names of die cast parts customarily produced; and (c) Machining, finishing and assembling facilities.

A

American Castings Co., 2140 Freeman avenue, Cincinnati.
(a) Aluminum, lead, tin and zinc base die castings, large and small.
(b) Gears, instruments, nameplates, automotive, etc.
(c) Polishing, painting, plating, and sand blasting.

Aurora Metal Co., 614 West Park avenue, Aurora, Ill.
(a) Aluminum bronze and silicon bronze die castings.
(b) Variety of machine parts.
(c) Complete facilities.

B

Badeger Die Casting Co., 1590 South First street, Milwaukee.
(a) Zinc alloy and aluminum alloy die castings, all sizes.
(b) Housings for gasoline or electric motors, etc.
(c) Complete facilities.

Benton Harbor Malleable Industries, Benton Harbor, Mich.
(a) Zinc base die castings, large and small.
(b) Automobile, coin machines, agricultural, machine tools; refrigerator hardware, handles, hinges, etc.; washing machines and ironers, phonographs and radios.
(c) Machining and finishing facilities.

C

Central Die Casting & Mfg. Co., 2935 West Forty-seventh street, Chicago.
(a) Zinc alloy and aluminum die castings, from fraction of an ounce to 20 lbs.
(b) Automotive, electrical, radio, coal stoker, coin machine, etc.
(c) Machining and finishing facilities.

Cleveland Electro Metals Co., 2391 West Thirty-eighth street, Cleveland.
(a) Zinc and aluminum die castings up to 18 in.
(b) To customers' specifications.
(c) None

Cleveland Hardware & Forging Co., 4518 Lakeside avenue, Cleveland.
(a) Aluminum and zinc from minute to 12½ lbs.
(b) Automotive, musical machines, vacuum cleaners, sewing machines.
(c) Complete facilities.

Congress Tool & Die Co., 9030 Lumpkin avenue, Detroit.
(a) Zinc alloy die castings, small to fairly large.
(b) Pulleys, flexible couplings, vending machine, washing machine, radio, woodworking machine and automotive parts.
(c) Complete facilities.

D

Dayton Die Casting Co., 303 Keowee street, Dayton, O.
(a) Zinc alloy, lead and tin die castings.
(b) To customers' specifications.
(c) Complete facilities.

Doehler Die Casting Co., Toledo, O. (Other plants at Batavia, N. Y., and Pottstown, Pa.)
(a) Zinc, aluminum, brass, bronze, tin, lead and magnesium die castings.
(b) All types of machine parts.
(c) Machining and finishing facilities.

Dollin Corp., 610 South Twenty-first street, Irvington, N. J.
(a) All sizes, in aluminum and zinc alloys.
(b) Variety of machine parts.
(c) Machining and finishing facilities.

Dow Chemical Co., Midland, Mich.
(a) Dowmetal and magnesium alloy die castings.
(b) All types of machine parts.
(c) None.

F

Federal-Mogul Corp., 11031 Shoemaker avenue, Detroit.
(a) Tin and lead base, medium and small, die castings.
(b) Primarily bearings and bushings.
(c) Complete facilities.

H

Hoover Co., The, Maple and McKinley streets, North Canton, O.
(a) Magnesium, aluminum and zinc die castings, to 24 in. square.
(b) To customers' specifications.
(c) Complete facilities.

I

Imperial Die Casting Co., The, 2850 West Fulton street, Chicago.
(a) Zinc and aluminum castings from 2 lbs. in aluminum, to 12 lbs. in zinc.
(b) Automotive, electrical and household machine parts.
(c) Complete facilities.

L

Latrobe Die Casting Co., Latrobe, Pa.
(a) Aluminum, zinc, tin and lead alloy die castings.
(b) Automotive, radio, office, household appliances, etc.
(c) Complete facilities.

M

Madison-Kipp Corp., 201 Waubesa street, Madison, Wis.
(a) Zinc, aluminum, magnesium, and brass die castings, all sizes.
(b) Automotive, household appliance, railway, etc.
(c) Complete facilities.

McGill Mfg. Co., Metal Division, Valparaiso, Ind.
(a) Aluminum bronze, and special hard bronze die castings from ½ oz. to 4 lbs.
(b) Gears and other corrosion resistant machine parts.
(c) Complete facilities.

Michigan Die Casting Co., 11831 Charlevoix avenue, Detroit.
(a) Zinc base die castings in all sizes.
(b) Any type of machine part.
(c) Machining and finishing facilities.

Milwaukee Die Casting Co., 1015 North Fourth street, Milwaukee.
(a) Lead-tin and zinc die castings; zinc to 5 lbs., tin and lead to 14 lbs. sizes.
(b) Motor cases, electrical apparatus, business machine, washing machine, etc.
(c) Machining and finishing facilities.

Modern Die Casting Corp., 430 South Green street, Chicago.
(a) Small and medium zinc die castings.
(b) Varied types of machine parts.
(b) Machining and assembling facilities.

N

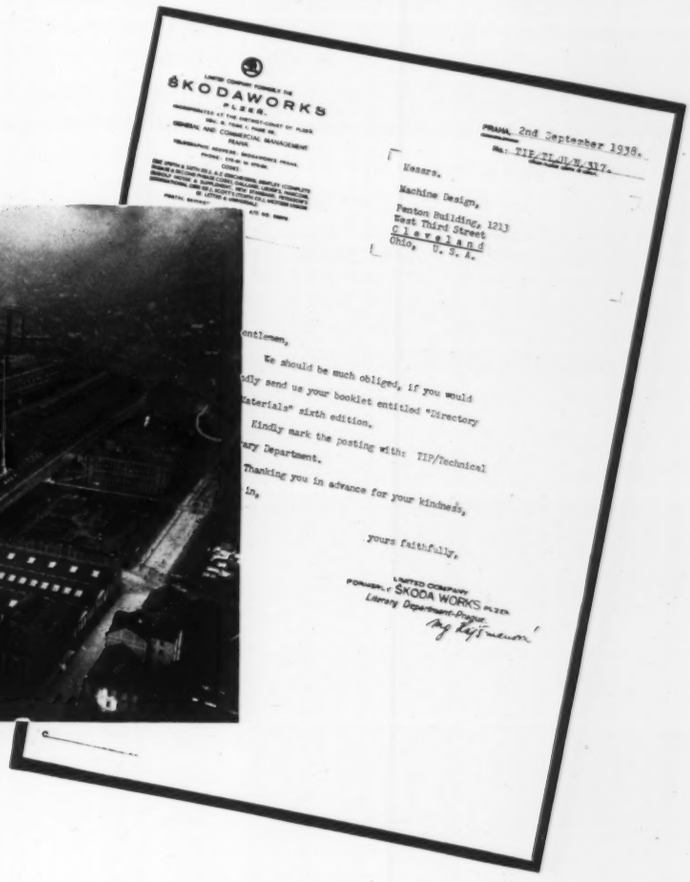
New Products Corp., Willow Drive, Benton Harbor, Mich.
(a) Zinc castings to 20 lbs., brass to 2 lbs.
(b) Household appliances, automotive, etc.
(c) Machining and assembling facilities.

P

Paragon Die Casting Co., 5851 West Dickens avenue, Chicago.
(a) Zinc and aluminum die castings, small and large.
(b) Auto, radio, washing machine, etc.
(c) Machining and plating facilities.

Parker White Metal & Machine Co., McKinley avenue at Twenty-third street, Erie, Pa.
(a) Zinc base die castings in any size.
(b) All types of machine parts.
(c) Complete facilities.

CZECHOSLOVAKIA'S GIANT SKODA WORKS comes to "MACHINE DESIGN" for MATERIALS INFORMATION



Skoda Works, Plzen, Czechoslovakia, is probably the most important producer of steel in Central Europe. Employing 40,000 men, it produces castings, forgings, structural steel, machinery, locomotives and guns.

Important and progressive machinery manufacturing plants must keep thoroughly posted on developments in materials. Like the Skoda Works, American manufacturers consider MACHINE DESIGN's Directory of Materials an invaluable reference book for their design departments.

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MACHINE DESIGN

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Phoenix Die Casting Co., 21 Illinois street, Buffalo.

(a) Zinc, tin and lead base alloy die castings.
(b) All types of machine parts.
(c) Complete facilities.

Precision Castings Co. Inc., Syracuse, N. Y. (also Cleveland)

(a) Zinc and aluminum die castings, large or small.
(b) Household appliances, etc.
(c) Complete facilities.

R

Rupert Die Casting & Stamping Corp., 1655 Cleveland avenue, Kansas City, Mo.

(a) Zinc alloy die castings.
(b) Washing machine, electrical, ornamental and automotive parts.
(c) Complete facilities.

S

Schilling, Geo. O., Bronze Co., 202-216 East North street, Rome, N. Y.

(a) Antimonial and brass die castings, from 1 oz. to 5 lbs.
(b) Nameplates, etc.
(c) Finishing and assembling facilities.

Shultz Die Casting Co., 1810 Clinton street, Toledo, O.

(a) Zinc base die castings.
(b) Automotive, etc.
(c) Machining and finishing facilities.

Sterling Die Castings Co. Inc., 743 Thirty-ninth street, Brooklyn, N. Y.

(a) Aluminum, zinc, lead and tin alloy die castings, from 1 oz. to 10 lbs.
(b) Scale parts, gasoline pumps, automotive, etc.
(c) Machining and assembling facilities.

Stewart Die Casting Corp., 4535 Fullerton avenue, Chicago.

(a) Zinc and aluminum castings up to 20 lbs.
(b) To customers' specifications.
(c) Finishing facilities.

Straight Line Foundry & Machine Corp., 218 South Geddes street, Syracuse, N. Y.

(a) Die castings.
(b) Goose necks, pressure chambers, nozzles, plungers, etc.
(c) Machining facilities.

Superior Die Casting Co., 17325 Euclid avenue, Cleveland.

(a) Zinc and aluminum alloy die castings.
(b) Dials, pulleys, bearing retainers, slingers, seals, levers, pump parts, etc.
(c) Machining facilities.

T

Titan Metal Mfg. Co., Bellefonte, Pa.

(a) Brass pressure die castings up to 3 lbs.
(b) Typewriter parts, etc.
(c) Machining and assembling facilities.

Toman, E., & Co., 2621 West Twenty-first place, Chicago.

(a) All types of zinc base die castings, from ½ oz. to 4 lbs.
(b) To customers' specifications.
(c) Complete facilities.

U

Union Die Casting Co. Ltd., 2313 East Fifty-first street, Los Angeles.

(a) All kinds of zinc alloy die castings.
(b) Vending, automotive, lubricating equipment, etc.
(c) Complete facilities.

V

Veeder-Root Inc., Hartford, Conn.

(a) Die castings to .001 tolerance if necessary.
(b) To customers' specifications.
(c) Complete facilities.

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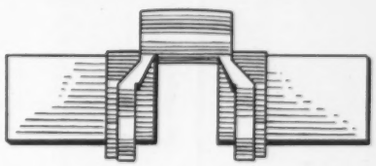

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Custom Molders of Plastics

Reference letters beneath addresses of companies refer to: (a) Types of materials utilized; and (b) Names of machine parts customarily molded.

A

Accurate Molding Corp., 116 Nassau street, Brooklyn, N. Y.
(a) BAKELITE, DUREZ, RESINOX, BEETLE, PLASKON, LUMARITH, MASURON, TENITE and POLYSTYRENE.
(b) Electrical power conductors and insulators, housings, permanent wave machine parts.

Ackerman Rubber & Plastic Molding Co., The, 986 East 200th street, Cleveland.
(a) BAKELITE, DUREZ, BEETLE, PLASKON, TENITE and THIOKOL.
(b) Mechanical, electrical and industrial.

American Insulator Corp., New Freedom, Pa.
(a) BAKELITE, DUREZ, PLASKON, BEETLE, LUMARITH, TENITE, PLASTACELE, LUCITE and cold-molded composition.
(b) Knobs, buttons, balls, dials and handles.

American Phenolic Corp., 1250 West Van Buren street, Chicago.
(a) BAKELITE, DUREZ, AMPHENOL, TENITE and SUNEX.
(b) Electrical small sections, special rods and tubes.

American Products Mfg. Co., 8127-33 Oleander street, New Orleans, La.
(a) TENITE, PLASTACELE and LUMARITH.
(b) Miscellaneous small parts not exceeding 4 oz.

Associated Attleboro Manufacturers Inc., 65 Union street, Attleboro, Mass.
(a) BAKELITE, DUREZ, RESINOX, PLASKON, BEETLE, LUMARITH, TENITE or any other acetate material.
(b) Compensator wheels, sheaves, cloth roll plugs.

Atlantic Plastic & Metal Parts Co., The, 2730 Grand avenue, Cleveland.
(a) BAKELITE, BEETLE, PLASKON, DUREZ, RESINOX, TENITE, LUCITE, PLASTACELE, LUMARITH, THIOKOL, etc.
(b) Safety supply parts, lighting and electrical, radio, chemical, mechanical, etc.

Auburn Button Works Inc., Auburn, N. Y.
(a) BAKELITE, DUREZ, RESINOX, BEETLE, PLASKON, TENITE and LUCITE.
(b) All types of machine parts.
See advertisement page 65D

B

Belmont Plastics Inc., 2100 Reading road, Cincinnati.
(a) PLASTACELE, TENITE, LUMARITH and FIBERLON.
(b) All types of injection molded machine parts.

Berkander Inc., George F., 891 Broad street, Providence, R. I.
(a) TENITE, LUMARITH and PLASTACELE.
(b) To customers' specifications.

Boonton Molding Co., 326 Myrtle avenue, Boonton, N. J.
(a) BAKELITE, DUREZ, RESINOX, TENITE, PLASTACELE, LUCITE, CRYSTALITE, STYRON, POLYSTYRENE, PLASKON and BEETLE.
(b) All types of machine parts to customers' specifications.

Breeze Corporations Inc., 24 South Sixth street, Newark, N. J.
(a) BAKELITE, BEETLE and DUREZ.
(b) Telephone, electrical, spool and magneto parts.

Bridgeport Moulded Products Inc., Bridgeport, Conn.
(a) BAKELITE, DUREZ, PLASKON and TENITE.
(b) To customers' specifications.

Bright Plastics Inc., 350 Huffman avenue, Dayton, O.
(a) Compound special molding materials.
(b) All types of injection molded machine parts.

Butterfield Inc., T. F., 56 Rubber avenue, Naugatuck, Conn.
(a) BAKELITE, DUREZ, MAKALOT, BEETLE, PLASKON, TENITE, LUMARITH, LUCITE, etc.
(b) Radio, heater switch, electrical, etc.

C

Chicago Molded Products Corp., 2147 Walnut street, Chicago.
(a) BAKELITE, DUREZ, RESINOX, PLASKON, BEETLE, TENITE, LUMARITH, PLASTACELE, LUCITE and POLYSTYRENE.
(b) Automotive, industrial, mechanical, scientific, surgical, electrical.

Cincinnati Molding Co., 2037 Florence avenue, Cincinnati.
(a) BAKELITE, RESINOX, DUREZ, PLASKON, BEETLE and other thermosetting molding materials.
(b) Electrical or mechanical to customers' specifications.

Colt's Patent Fire Arms Mfg. Co., Hartford, Conn.
(a) All plastic materials.
(b) All types of machine parts.

Commonwealth Plastic Co., Leominster, Mass.
(a) TENITE, LUMARITH, PLASTACELE, LUCITE and POLYSTYRENE.
(b) Radio knobs and escutcheons, remote control cases, automotive, hardware, etc.

Consolidated Molded Products Corp., Scranton, Pa.
(a) BAKELITE, DUREZ, TENITE, LUMARITH, LUCITE, PLASKON, BEETLE, LACANITE and shellac composition.
(b) Knobs, handles, wheels, terminal bases, bushings, switches, etc.

Continental-Diamond Fibre Co., Newark, Del.
(a) CELORON, DILOPHANE and DILECTO.
(b) Gears, couplings, aircraft parts, etc.

Cutler-Hammer Inc., 315 North Twelfth street, Milwaukee.
(a) THERMOPLAX and PYROPLAX.
(b) Terminal blocks, insulators, switch bases, knobs, handles, insulating bushings, arc shields and miscellaneous electrical insulating forms.

D

Davies Molding Co., Harry, 1428 North Wells street, Chicago.
(a) BAKELITE, DUREZ, RESINOX, PLASKON and BEETLE.
(b) Stock knobs and handles; also custom molded parts.

Detroit Macoid Corp., 12340 Cloverdale avenue, Detroit.
(a) TENITE, LUMARITH, FIBERLOID, MASURON and other cellulose-acetate or thermoplastic materials.
(b) All types of injection molded machine parts.

Detroit Molded Products Co., 253 Vinewood avenue, Detroit.
(a) DUREZ, INDUR, BEETLE, PLASKON, TENITE, LUMARITH, PLASTACELE, FIBERLOID, LUCITE, etc.
(b) Automotive, refrigeration, stove, business machine, etc.

Diemolding Corp., Canastota, N. Y.
(a) BAKELITE, DUREZ, PLASKON, BEETLE, TENITE or any other plastics of similar nature.
(b) Control handles or knobs, small bases and plates, housings, etc.

E

Eclipse Moulded Products Co., Milwaukee.
(a) BAKELITE, DUREZ, PLASKON, BEETLE, LUMARITH, LUCITE, TENITE and RESINOX.
(b) Valve handles, insulator parts, housings, transparent casings, knobs, switch buttons, control covers, cams and pulleys.

Emeloid Co. Inc., The, 287 Laurl avenue, Arlington, N. J.
(a) TENITE, LUCITE, PLASTACELE, LUMARITH and POLYSTYRENE.
(b) Small parts weighing 2 oz. or less.

Erie Resistor Corp., 640 West Twelfth street, Erie, Pa.
(a) TENITE, LUMARITH, LUCITE, STYRENE, and PLASTACELE.
(b) Radio, refrigerator, automotive, handles, knobs, etc.

Eureka Button Co., Molded Plastics Div., 892 Broadway, New York.
(a) BAKELITE, PLASKON, BEETLE, DUREZ and similar compounds.
(b) Switch bases and knobs, insulation blocks, handles for ranges and electric razors, etc.

G

General Electric Co., Plastics Dept., One Plastics avenue, Pittsfield, Mass.
(a) TEXTOLITE (molded, laminated and cold-molded).
(b) All types to customers' requirements.

General Industries Co., International Insulating Div., Elyria, O.
(a) BAKELITE, DUREZ, RESINOX, PLASKON, BEETLE, TENITE, LUMARITH, PLASTACELE, LUCITE and CRYSTALLITE.
(b) Special parts to customers' specifications.

Gits Molding Corp., 4600 West Huron street, Chicago.
(a) TENITE, LUMARITH, PLASTACELE, MASURON, LUCITE, BAKELITE and POLYSTYRENE.
(b) Radio knobs and cabinets, push-buttons, escutcheons, dials, supports and insulators.

Gorham Co., Plastics Div., Elmwood Station, Providence, R. I.
(a) BAKELITE, DUREZ, RESINOX,

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American Felt Company

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"Manufacturers of Quality Felts for All Mechanical Purposes"

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Jobs, like the socket illustrated above from the top and in cross section, molded in one piece with undercut inside "L" shaped slots, threaded base and screw inserts, are tough ones to hand any molder. But, here at Auburn, they are the kind we take real pride in licking. They give us a chance to apply the knowledge we have acquired through more than 60 years of pioneering experience. They prove, also, the value of the many inspections that we make at every step of the work.

The next time you have a tough job on the docket and want it done right, at a reasonable price, and delivered on time, why not turn the specifications over to Auburn.

Established 1876

MOLDED PLASTICS DIVISION OF
AUBURN BUTTON WORKS, Inc.
AUBURN, N. Y.—New York, Chicago, Detroit, Cleveland, Rochester, Boston

MAKALOT, BEETLE, PLASKON, LUCITE, TENITE, PLASTACELE, LUMARITH and FIBERLOID.
(b) All types to customers' specifications.

Grigoleit Co., The, 740 East North street, Decatur, Ill.
(a) BAKELITE, DUREZ, INDUR, RESINOX, PLASKON and BEETLE.
(b) Molded composition, knobs, handles and caps.

H

Haveg Corp., Newark, Del.
(a) HAVEG.
(b) Acid-resistant equipment, standard tanks, piping, fittings, fume duct, towers, etc.

Hyde, A. L., Greenloch, N. J.
(a) BAKELITE, RESINOX, TENITE and PLASTACELE.
(b) All types of pressure and injection molded machine parts.

I

Imperial Molded Products Corp., 2925 West Harrison street, Chicago.
(a) BAKELITE, PLASKON, DUREZ, BEETLE and TENITE.
(b) All types of compression molded parts.

Industrial Molded Products Co., 2035 Charleston street, Chicago.
(a) BAKELITE, DUREZ, RESINOX, MAKALOT, PLASKON, BEETLE, etc.
(b) Various types of machine parts.

Insulation Products Co., 504 North Richmond street, Pittsburgh.
(a) BAKELITE, DUREZ, TENITE and PLASKON.
(b) Parts to customers' specifications.

International Molded Plastics Inc., 4384 West Thirty-fifth street, Cleveland.
(a) PLASKON, BEETLE, DUREZ, TENITE, LUCITE and BAKELITE.
(b) All types of machine parts.

K

Keolyn Plastics Co., 2731 North Pulaski road, Chicago.
(a) PLASTACELE, TENITE, LUMARITH and other cellulose acetate materials.
(b) Knobs and handles.

Keystone Specialty Co., 1373½ Cove avenue, Lakewood, O.
(a) Any material to customers' specifications.
(b) Parts to customers' specifications.

Kuhn & Jacob Moulding & Tool Co., 1200 Southard street, Trenton, N. J.
(a) BAKELITE, DUREZ, BEETLE, PLASKON, TENITE, LUCITE, LUMARITH, etc.
(b) Compression molding of electrical, automotive, radio, airplane, instrument, permanent wave machine parts, etc.

Kurz-Kasch Inc., 1421 South Broadway, Dayton, O.
(a) BAKELITE, DUREZ, BEETLE, PLASKON, LUMARITH, TENITE, CRYSTALLITE and LUCITE.
(b) General molded parts.

L

Los Angeles Molding Co., 1702 East Sixty-first street, Los Angeles.
(a) DUREZ, PLASKON, BEETLE and BAKELITE.
(b) Handles, knobs and insulators.

M

Mack Molding Co. Inc., Ryerson avenue, Wayne, N. J.
(a) BAKELITE, DUREZ, TENITE, BEETLE, LUMARITH, FIBESTOS and PLASKON.
(b) Parts to customers' specifications.

Midwest Molding & Mfg. Co., 17 North Loomis street, Chicago.
(a) BAKELITE, DUREZ, BEETLEWARE, PLASKON and other thermosetting compounds.
(b) All types of machine parts.

Mills Corp., Elmer E., 812 West Van Buren street, Chicago.
(a) TENITE, PLASTACELE, MASURON, LUCITE, LUMARITH, NIXON ACETATE, FIBERLON, etc.
(b) To customers' specifications.

Modern Plastics Corp., Benton Harbor, Mich.
(a) Phenolic, cellulose, etc., materials.
(b) Parts to customers' specifications.

Molded Insulation Co., 3246 Ludlow street, Philadelphia.
(a) BAKELITE, DUREZ, RESINOX, DURITE, BEETLE, PLASKON, TENITE and LUCITE.
(b) Aircraft, radio, electrical and other machine parts.

N

National Lock Co., Rockford, Ill.
(a) BAKELITE, BEETLE, PLASKON, DUREZ and TENITE.
(b) Handles, pulls, stove and refrigerator trim.

Norris Co., The, Paul A., 101 West Second street, Wellston, O.
(a) TENITE, FIBESTOS, LUMARITH, PLASTICLE and all acetate molding materials.
(b) Housings for machinery, handles, knobs, etc.

Northern Industrial Chemical Co., 7 Elkins street, South Boston, Mass.
(a) BAKELITE, DUREZ, BEETLE, PLASKON, TENITE, LUMARITH, etc.
(b) Any molded part to customers' specifications.

Norton Laboratories Inc., 520 Mill street, Lockport, N. Y.
(a) BAKELITE, DUREZ, PLASKON, BEETLE, TENITE, LUMARITH, LUCITE, PLASTACELE and FIBERLOID.
(b) Housings, terminals, bushings, wheels, knobs, handles, etc.

O

Oris Mfg. Co., P. O. Box 250, Thomaston, Conn.
(a) BAKELITE, DUREZ, RESINOX, PLASKON and BEETLE.
(b) Parts up to 70 square inches in area.

R

Recto Molded Products Inc., Appleton and B. & O. R. R., Oakley, Cincinnati.
(a) DUREZ, BAKELITE, TENITE, LUMARITH, RESINOX and PLASKON.
(b) All types to customers' specifications.

Reinhold, F. E., 7001 McKinley avenue, Los Angeles.
(a) BAKELITE and BEETLE.
(b) Electrical parts, radio cabinets, etc.

Reynolds Molded Plastics Div. Reynolds Spring Co., Jackson, Mich.
(a) BAKELITE, PLASKON, TENITE, LUMARITH, BEETLE, DUREZ and LUCITE.
(b) All types to customers' specifications.

Richardson Co., The, 27th and Lake streets, Melrose Park, Chicago.
(a) INSUROK, EBROK and RUB-TEX.
(b) All types to customers' specifications

See advertisement page 63D

S

Sheller Mfg. Co., Portland, Ind.
(a) TENITE, LUMARITH, PLASTACELE, RESINOX, BAKELITE, and miscellaneous plastics.
(b) Automotive and miscellaneous.

Siemon Co., The, Bridgeport, Conn.
(a) HARVITE.
(b) Switch handles.

Stokes Rubber Co., Jos., Taylor and Webster streets, Trenton, N. J.
(a) BAKELITE, DUREZ, BEETLE, PLASKON, LUMARITH and TENITE.
(b) All types to customers' specifications.

T

Tech-Art Plastics Co., 41-01 Thirty-sixth avenue, Long Island City, N. Y.
(a) BAKELITE, RESINOX, MAKALOT, DUREZ, BEETLE and TENITE.
(b) All types to customers' specifications.

Terkelsen Machine Co., 326 A street, Boston.
(a) BAKELITE, DUREZ, INDUR, MAKALOT, PLASKON and BEETLE.
(b) All types to customers' specifications.

Ther Electric & Machine Works, 17 South Jefferson street, Chicago.
(a) DUREZ, CATALIN, KOLONITE, PLASKON and BEETLE.
(b) All types of customers' specifications.

Thermo-Plastics Inc., Div. of The Standard Products Co., St. Clair, Mich.
(a) BAKELITE, ETHOCEL, FIBESTOS, HERCULES, LUMARITH, MASURON, PLASTACELE, POLYSTYRENE, TENITE and VINYLITE.
(b) Business machine parts, clock cases, instrument panels, radiator grilles, radio cabinets, scale bases, steering wheels, as well as all smaller applications.

U

Union Insulating Co., Box 315, Parkersburg, W. Va.
(a) BAKELITE, PLASKON and DUREZ.
(b) Any type to customers' specifications.

Universal Molding Co., Sixteenth and Vermont streets, San Francisco.
(a) BAKELITE, DUREZ, BEETLE, PLASKON, TENITE and LUMARITH.
(b) To customers' specifications.

Universal Plastics Corp., 235 Jersey avenue, New Brunswick, N. J.
(a) BAKELITE, DUREZ, RESINOX, PLASKON, BEETLE, LUMARITH, FIBESTOS, TENITE, MASURON and LUCITE.
(b) Radio parts and cabinets, handles and knobs.

V

Van Norman Molding Co., 6437 South State street, Chicago.
(a) BAKELITE, DUREZ and PLASKON.
(b) Knobs, handles and insulating parts.

Voges Mfg. Co. Inc., 99th street near 103 avenue, Ozone Park, N. Y.
(a) BEETLE, LUCITE and CASEIN PLASTICS; PHENOLIC MOLDING COMPOUNDS, CAST PHENOLICS.
(b) Electrical parts for instruments.

W

Ward Plastic & Rubber Co., 1037 Hilton road, Ferndale, Mich.
(a) All thermoplastic and thermosetting materials.
(b) Condulet boxes, coil bobbins, bearings, handles, oil seals, pump parts such as washers, seals, stators, and various electrical parts.

Waterbury Button Co., The, 39 River street, Waterbury, Conn.
(a) BAKELITE, DUREZ, BEETLE, PLASKON, TENITE, LUCITE, SHELLAC COMPOSITION, LUMARITH, RESINOX, CRYSTALLITE, etc.
(b) All types to customers' specifications.

Watertown Mfg. Co., Echo Lake road, Watertown, Conn.
(a) NEILLITE, BAKELITE, DUREZ, RESINOX, TENITE, LUMARITH, FIBESTOS, PLASTACELE, LUCITE, BEETLE and PLASKON.
(b) Contact blocks, insulator blocks, switch housings, cams, spacers and any other moldable parts.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
(a) MICARTA.
(b) To customers' specifications.

Windman Brothers, 3325 Union Pacific avenue, Los Angeles.
(a) BAKELITE, DUREZ, PLASKON, BEETLE, all phenolics and ureas; STEARINES, acrylic resins and TENITE or cellulose acetates.
(b) Electric razor cases, radio cabinets, electrical, mechanical, dental, photographic and surgical parts.

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MACHINE DESIGN

as it affects

ENGINEERING

PRODUCTION

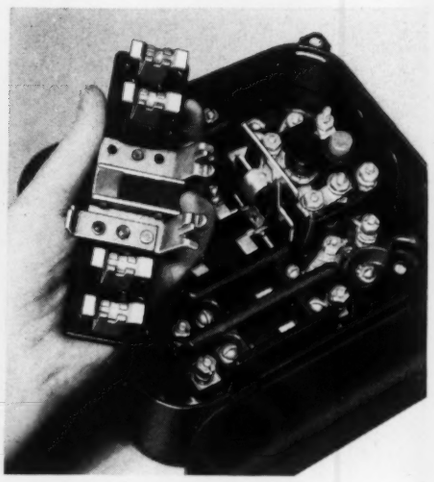
SALES

Parts . . . . Materials . . . . Methods . . . . Finishes

OF MACHINES OF EVERY SIZE AND TYPE

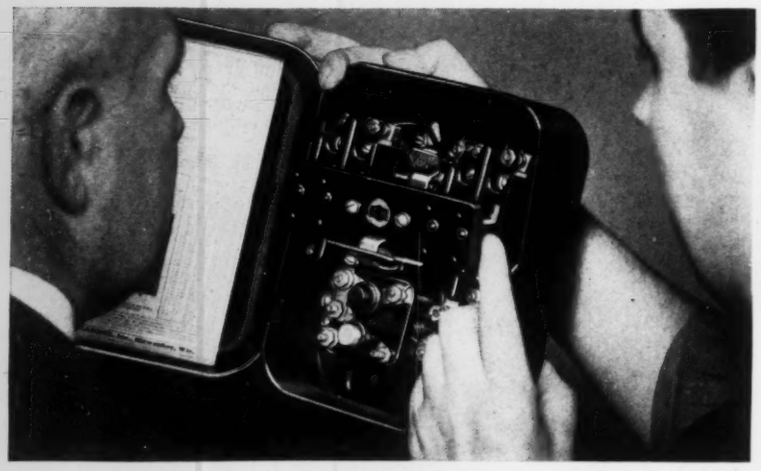
"NOW THE BOSS KNOWS WHY!"

1 "Never mistake size as a measure of importance in Motor Control. The failure of a single small motor of 5 h.p. or less can frequently upset operations and cause big losses. It's just good business to buy the best Motor Control for *any* size motor."



2 "And there certainly is a difference in Motor Control. See how easily this entire contactor unit is removed so the correct magnet coil for any specific job can be inserted or the contacts themselves can be inspected in a jiffy. And these contacts are *solid* silver, believe it or not."

3 "Here's some more *real* design that speaks volumes about the manufacturer's experience. See these pivots or bearings for the moving parts? They prevent sloppy, noisy operation, assure correct alignment of contacts and positive contact pressure. No sliding parts to cause friction, wear, and trouble."



4 "You saw those 'twin-break' silver contacts that break up arcing. Now see how they open . . . *horizontally* . . . so that even the semi-arc produced can automatically lengthen *upward* to carry the heat *away*. It simply licks the problem of burning and pitting of contacts."

5 "And here's the most important part of Motor Control . . . the overload protection. This Cutler-Hammer Eutectic Alloy Relay is the smartest invention of its kind. It keeps the motor working right up to the danger point and *no* farther. It is absolutely dependable, unaffected by dust or temperature changes. No adjustments to make or go out of order. No parts to replace. Easily and simply reset."

6 "I am sure we have tried every kind of Motor Control made, but the more we compared, the more we liked Cutler-Hammer. Since we have standardized on Cutler-Hammer we have simplified our stock room problem and have effected better service to all our departments. So many Cutler-Hammer parts are interchangeable . . . we should have standardized this way years ago."

"And when it's all said and done, there's no substitute for experience. Cutler-Hammer have over 40 years of specialized experience behind their engineering—and their world wide leadership in Motor Control is certainly a valid guarantee of satisfaction anywhere."
CUTLER-HAMMER
MOTOR CONTROL
C-H

© CUTLER-HAMMER, Inc., *Pioneer Electrical Manufacturers*, 1319 St. Paul Avenue, Milwaukee, Wisconsin.

All Structural Parts of This Equipment
Are Made Lighter, Yet Stronger with Inland Hi-Steel
You make a daily saving in the operating cost of this equipment because it is about 25% lighter than if built with equal strength of ordinary steel. Being lighter, it saves power, handles more pay load in each operation and handles much more quickly and conveniently. Inland Hi-Steel has about twice the yield strength of ordinary steel. Our choice of Inland Hi-Steel has been guided by extensive research into its special advantages for your purposes.
Extra Corrosion Resistance—Longer Service
Inland Hi-Steel is more resistant to atmospheric corrosion than even copper-bearing steel. Therefore it gives added life when exposed to moisture and weather; and your equipment retains higher re-sale value. Inland Hi-Steel also has fabrication advantages which enable us to give you a better built, welded unit at a remarkably low price.
THE JOHN DOE EQUIPMENT COMPANY

Inland Hi-Steel is economical to fabricate. No special equipment is required. It cuts and punches without burr, requires no special heat-treatment and welds readily by all welding methods in use. Write for detailed bulletin. — Inland Steel Co., 38 So. Dearborn St., Chicago, Ill.

New customers will be attracted to purchase your product when you build it lighter yet stronger with Inland Hi-Steel . . .

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CHICAGO, ILLINOIS

59 Years Manufacturing Quality Mechanical Leather Goods Exclusively

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CLASSIFIED FOR CONVENIENCE WHEN STUDYING SPECIFIC DESIGN PROBLEMS

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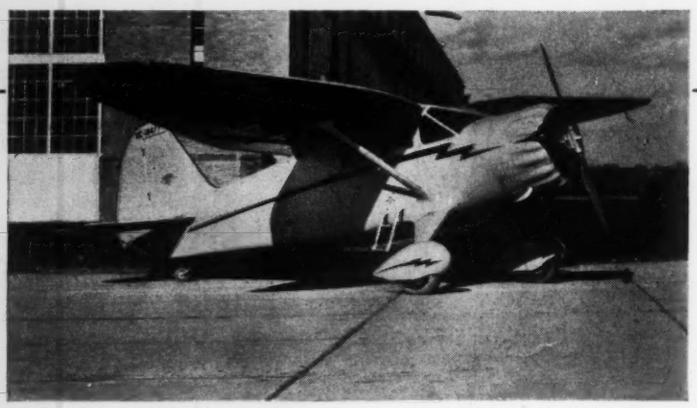
How increasing use of
WELDING
makes stronger, safer planes



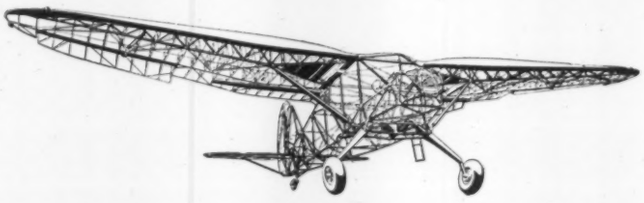
THIS four-passenger cabin cruiser has all-metal construction in wings and fuselage. The entire frame structure, illustrated below, is oxy-acetylene welded. Because oxy-acetylene welds can be made to duplicate the strength, toughness, and corrosion-resistance characteristics of the chrome-molybdenum tubing used, the structure is light in weight yet can safely resist great stresses and shocks.

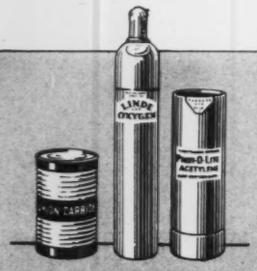
Even a decade ago, oxy-acetylene welding was used in the construction of 95 per cent of the airplanes built in this country. Today, the exacting demands of quality and performance in the manufacture of aircraft have extended the use of welding to practically all planes.

Other Oxy-Acetylene Applications

Welding is one of many applications of the oxy-acetylene process which are useful and profitable in the manufacture of equipment. Parts requiring the strength and toughness of rolled steel can be flame-cut to desired shape from stock material. Parts subject to exceptional wear can be flame-hardened or hard-faced. Where annealing is required, surfaces can be flame-softened.

Why not decide today to investigate the possibilities of this process in your operations? Notice how little you need to invest to make full use of this modern metalworking tool. In the meantime, if you will write to the nearest Linde office, we will be glad to send you a booklet from which you can select our current literature of greatest interest to you—"The Linde Library."





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Unit of Union Carbide and Carbon Corporation

New York and UCC Principal Cities

In Canada: Dominion Oxygen Company, Limited, Toronto

Everything for Oxy-Acetylene Welding and Cutting

LINDE OXYGEN • PREST-O-LITE ACETYLENE • OXWELD APPARATUS AND SUPPLIES • UNION CARBIDE

The words "Linde," "Prest-O-Lite," "Oxweld" and "Union" used herein are trade-marks.

the Screw

A rough character he was, see . . . a constant headache in every plant he ever worked in. Crooked every chance he got . . . wasting time, spoiling work, bogging down production. Liked by nobody — and when in a jam, what a nasty job of cutting up he could do!

goes straight

Then something came over The Screw. Took that slot off his head and put in a patented recess. Changed his habits altogether. Guarantees now never to go crooked again, to use his head and really save some money.

The crew took to him like your wife to a pay envelope. He's on the ball from whistle to whistle, and no foolin'! Makes it easy for the guy that's doing the driving, because you can depend on him to keep the driver from slipping. No more burrs — really a smooth article now. And I don't know of a crooked job he's done since he made his comeback.

The boss says he's worth his weight in gold. The Screw has gone straight — and you can lay your cash on that!

Phillips Screw Gives Designers Opportunity to Strengthen Assemblies

The shape of the recess in the genuine patented Phillips Screw was carefully worked out to make the most efficient use of the driver's turning power. It presents three times the contact of the slotted screws, reducing the effort required to drive, as a result, making assemblies tighter. Increased holding power makes it often possible to use fewer screws or smaller, lower-cost sizes.

Note the flat surfaces in the recess — no curves except at the rim. Phillips Screws can't be burred — a valuable asset when specified for jobs where clothes might be torn. Cold forged to tolerances of plus or minus .001″ — to guarantee a perfect fit.

Folder B contains more facts. Address one of the firms listed below for a free copy.

The recess in the genuine patented Phillips Screw was carefully designed to make the most efficient use of the driver's turning power. It presents three times the contact of the slotted screw, reducing effort required. 2 Phillips Drivers fit 85% screw sizes commonly used.

RECESSED HEAD

PHILLIPS SCREWS

Gain Time . . . Guide-Driver . . . Guard Work

MACHINE SCREWS SHEET METAL SCREWS WOOD SCREWS STOVE BOLTS

U. S. Patents on Product and Methods Nos. 2,046,343; 2,046,837; 2,046,839; 2,046,840; 2,082,085; 2,084,078; 2,084,079; 2,090,338. Other Domestic and Foreign Patents Allowed and Pending.

American Screw Company, Licensor
Providence, Rhode Island

National Screw & Manufacturing Company
Cleveland, Ohio

Continental Screw Company
New Bedford, Massachusetts

Parker-Kalon Corporation
New York, New York

Corbin Screw Corporation
New Britain, Connecticut

Russell, Burdsall & Ward Bolt & Nut Company
Port Chester, New York

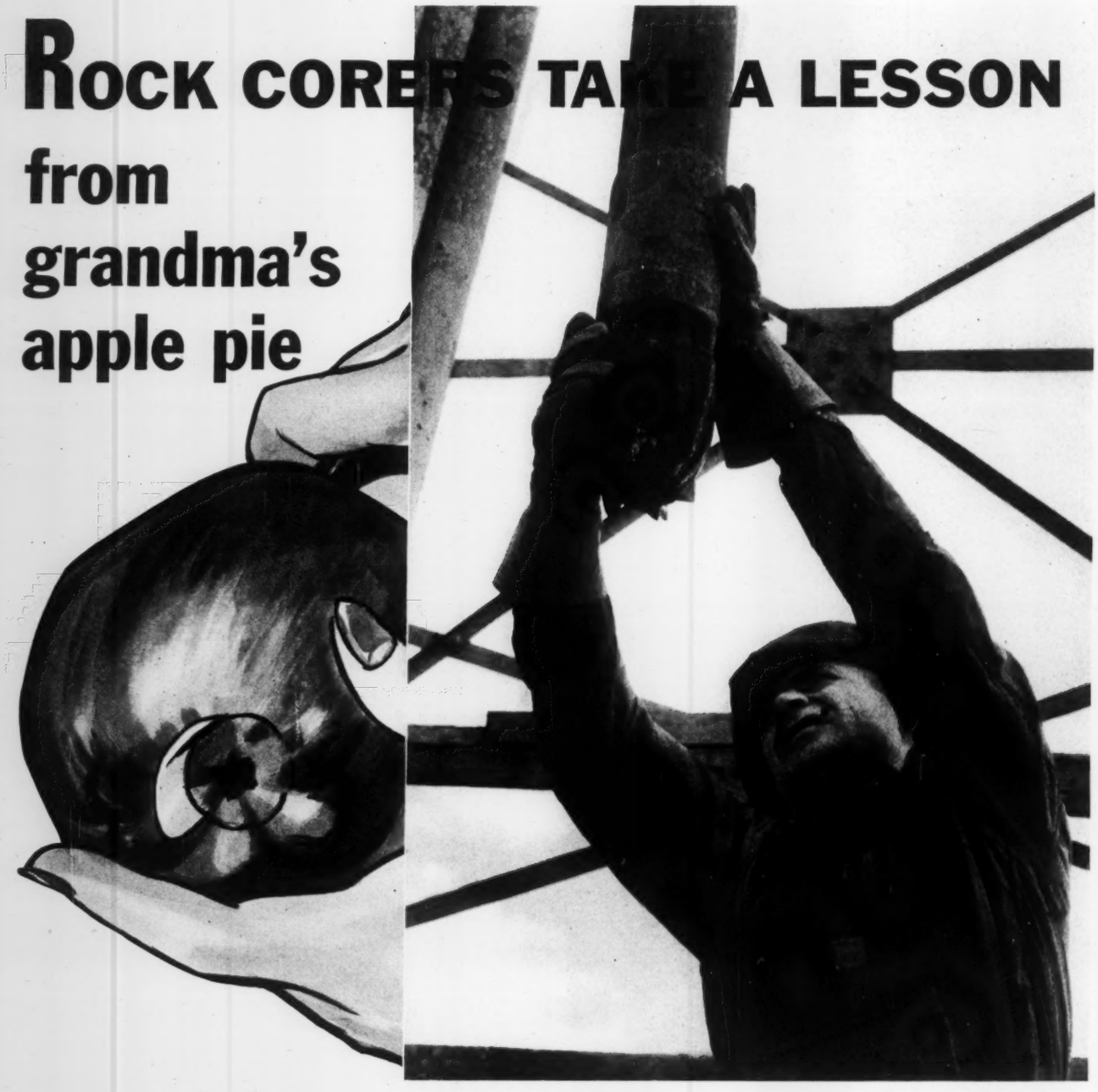
SEND ME FOLDER B ON PHILLIPS SCREWS! (Address your inquiry to one of the firms listed above.)

Name .....

Company ..... Products .....

Address .....

ROCK CORES TAKE A LESSON from grandma's apple pie



and avoid "torsional strain" with neoprene swivel bearings

IN getting a sample rock core from the earth, as in coring an apple, it's important to cut and lift the core with a minimum of torsional strain. Else it comes apart . . . and deep in the ground, of course, this is a lot more serious than seeds in your apple pie.

The oil well driller must have an unbroken rock core to read its message correctly. But it has been a common and unfortunate experience to find cores broken because improperly lubricated or inadequate bearings do not permit free rotation of the core catcher.

A prominent manufacturer, however, recently developed a core catcher with a swivel bearing which solved the lubrication problem once and for all. He made the bearing of neoprene, Du Pont's remarkable chloroprene rubber. For tests had proved neoprene to be the only material which would stand up when lubricated with mud, oil or water . . . one or more of which are always present in the drill stem.

* * *

We mention this case simply as another example of the many widespread uses of Du Pont neoprene, which resists oil, heat, ozone and many acids which deteriorate natural rubber. It may suggest how you, too, can use this remarkable material in your own business. Write for further details.

DU PONT
REG. U.S. PAT. OFF.

Specify
NEOPRENE
where other materials fail

E. I. DU PONT DE NEMOURS & CO., INC.
RUBBER CHEMICALS DIVISION
WILMINGTON, DELAWARE

"Now we can get Prints when we want them—

and they're BRUNING BLACK AND WHITE PRINTS"

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Bruning Model 149 BW Developer

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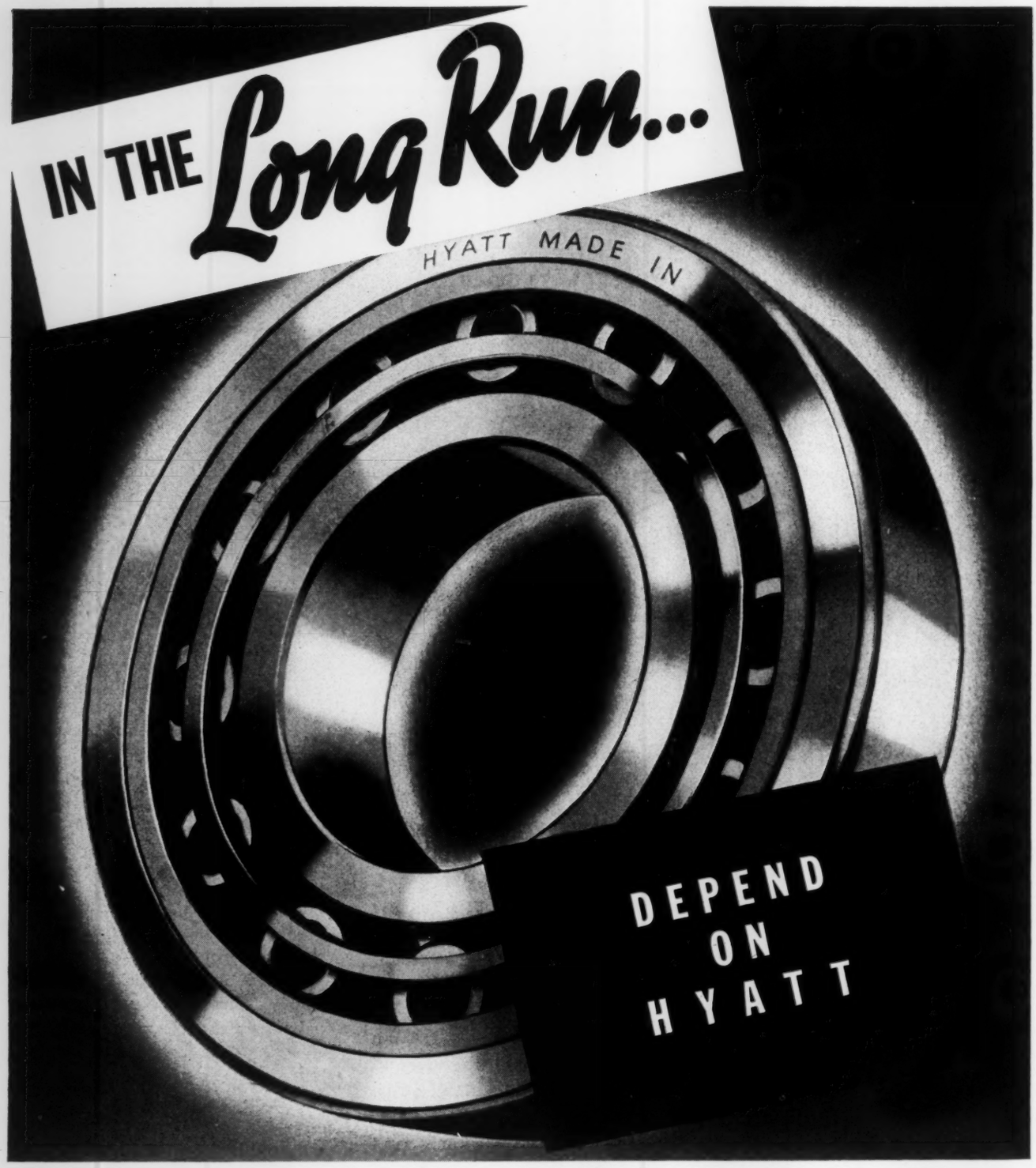
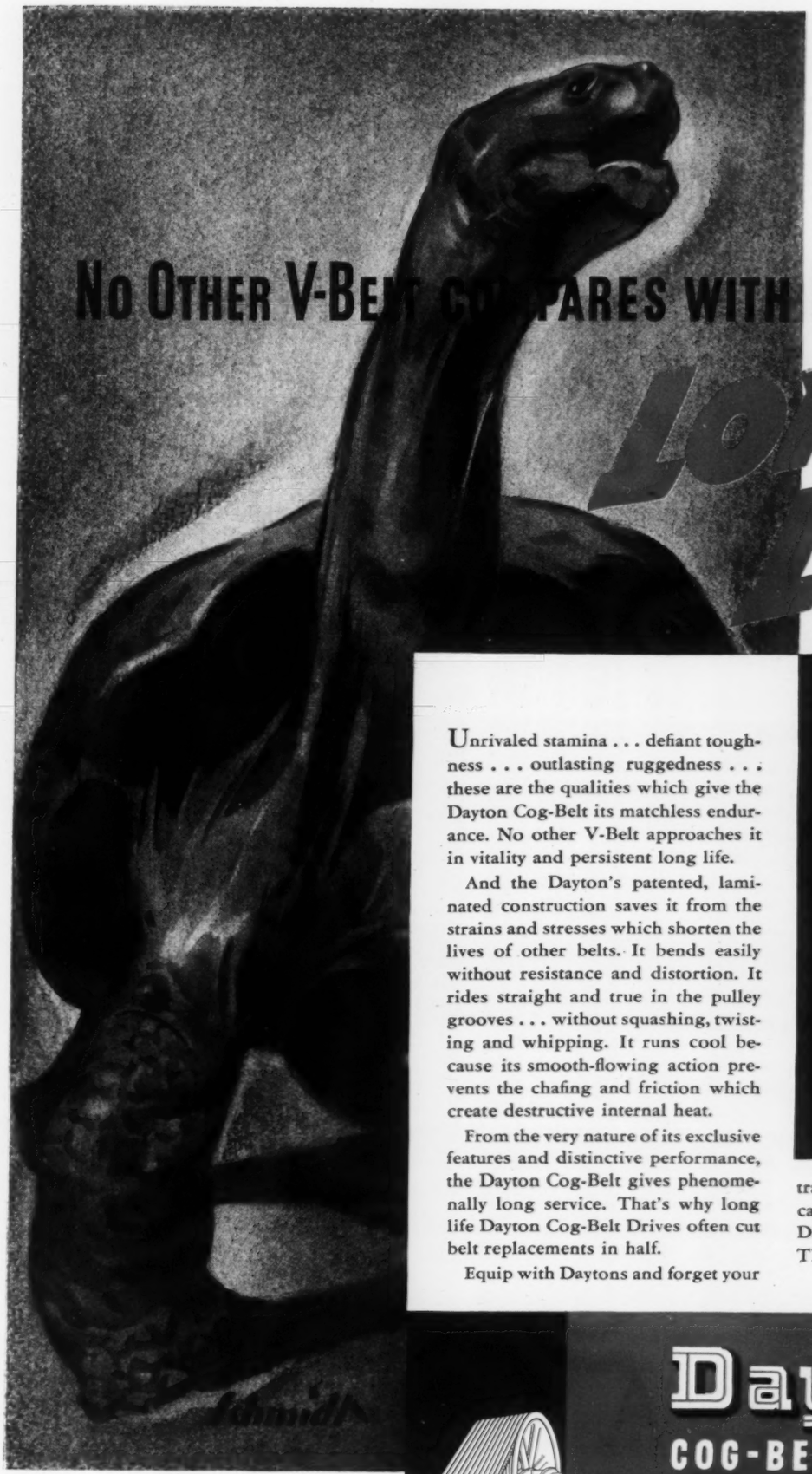


Evidence of Hyatt reliability is found everywhere. In service on wheels, on shafts, and gears, Hyatt Roller Bearings are sturdy, smooth and quiet . . . faultless in design and workmanship, carefree in operation. The millions of Hyatts applied each year to new equipment roll on unheeded, except by the engineers, who have learned to specify and depend on Hyatt Roller Bearings. Hyatt Bearings Div., General Motors Corp., Harrison, N. J.; San Francisco. Hyatt Roller Bearing Sales Company, Chicago and Pittsburgh.

HYATT *Roller* BEARINGS



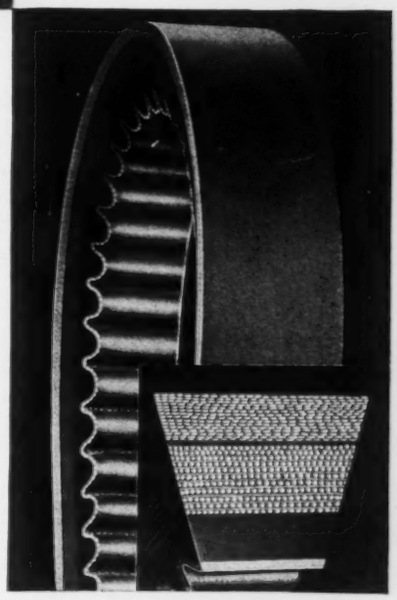
NO OTHER V-BELT COMPARES WITH DAYTON FOR LONG LIFE

Unrivaled stamina . . . defiant toughness . . . outlasting ruggedness . . . these are the qualities which give the Dayton Cog-Belt its matchless endurance. No other V-Belt approaches it in vitality and persistent long life.

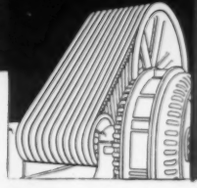
And the Dayton's patented, laminated construction saves it from the strains and stresses which shorten the lives of other belts. It bends easily without resistance and distortion. It rides straight and true in the pulley grooves . . . without squashing, twisting and whipping. It runs cool because its smooth-flowing action prevents the chafing and friction which create destructive internal heat.

From the very nature of its exclusive features and distinctive performance, the Dayton Cog-Belt gives phenomenally long service. That's why long life Dayton Cog-Belt Drives often cut belt replacements in half.

Equip with Daytons and forget your transmission troubles. Write us for catalogs and data, or call your local Dayton distributor.



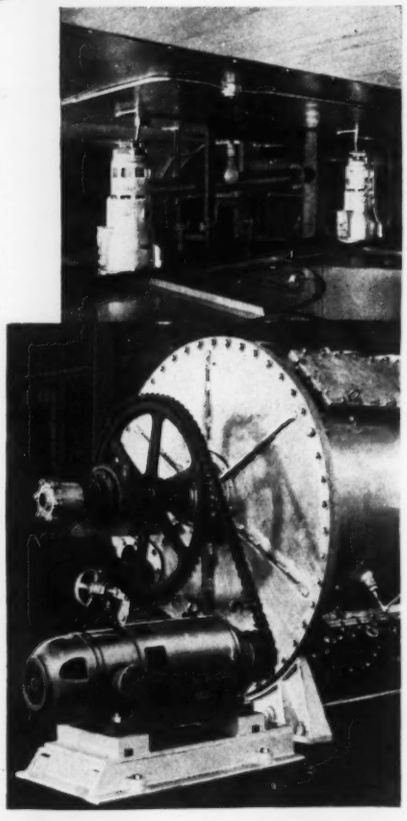
THE DAYTON RUBBER MFG. CO.
DAYTON, OHIO



Dayton
COG-BELT DRIVES

This New York skyline was modern . . . ONCE

Can the same be said about your Drive Equipment?



The use of hopelessly out of date drive equipment is false economy. Giant strides have been made in this type equipment during the last decade making it paramount for the management in every shop to carefully study their drives for possible future economies.

Today's requirements demand the PHILADELPHIA MOTOREDUCER

Therein are combined the latest developments in sound, advanced engineering principles, as well as many original outstanding advantages, each of practical value to industry. The single casing and the built-in feature of the motor and reduction gears, in both horizontal and vertical types, conserves space and assures better alignment of gears and pinions, greatly reducing noise and wear.

We offer an unprejudiced selection of all types with any type AC or DC motor. Our engineers can suggest the unit best suited to your needs. Write us about them.

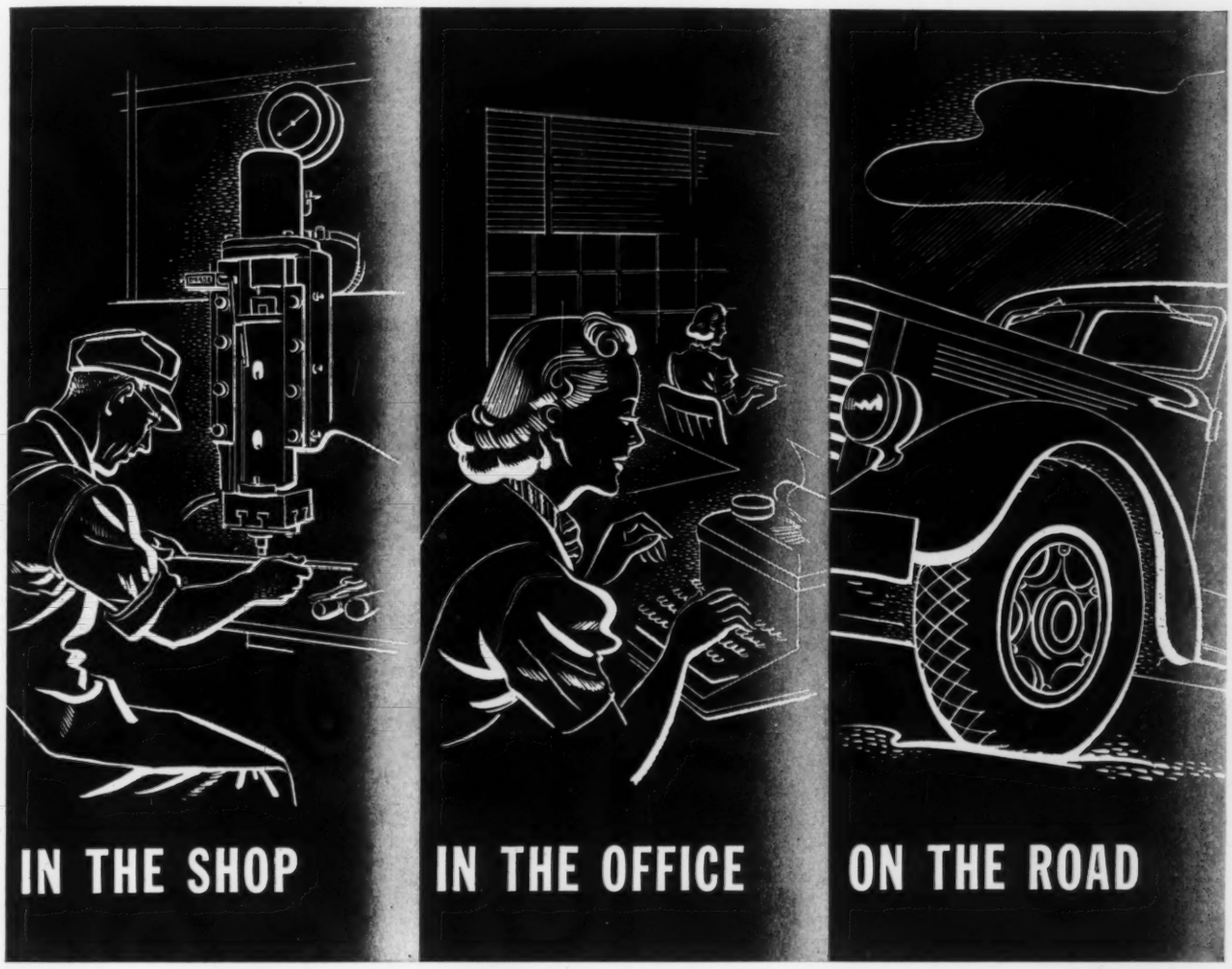
PHILADELPHIA

MOTOREDUCER

PHILADELPHIA GEAR WORKS

Industrial Gears and Speed Reducers

ERIE AVENUE AND G STREET, PHILADELPHIA



Machines can profit by built-in Veeder-Root counters

Management wants machines that count—machines that tell what they do—that give performance figures that form the basis of cost control, maintenance allowances, mileage costs, economy programs and efficient manufacturing. That is why typewriters, billing machines, presses, looms, fillers, cutters, trucks, and hundreds of others are equipped with Veeder-Root Counters.

Machines servicing practically all branches of industry use many types of Veeder-Root devices for counting, measuring, recording, or computing. Some of these applications are simple economical jobs. Others are special devices designed and installed through the cooperation of manufacturers and Veeder-Root's engineering staff. Almost all have resulted in a more practical, more salable product.

Can your product profit by a built-in Veeder-Root Counting device? Send for our free booklet "Counting Devices" now.

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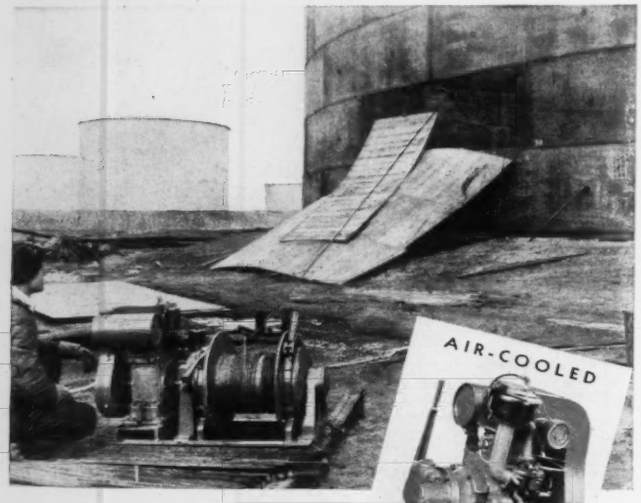
"POWER TO FIT THE JOB"



This very compact, efficient little hoist depends on a Wisconsin single-cylinder air-cooled engine for power.

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9 Sizes
Single and 4 Cyl.
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HEAVY DUTY AIR COOLED ENGINES by WISCONSIN MOTOR CORPORATION

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SPIRALS
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14 to 96 D. P.

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GEARING

—such as these, and numerous others, are the logical product of a skilled organization with a deft 'feel' for *precise* work. . . . Note the *Combination* Worm-gear, rotating as a Gear on one side and as a Worm on the opposite side.

Made to order only — No stock — No catalog

Gear Specialties
INCORPORATED
CHICAGO

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Charles F. Roth, International Exposition Co., Grand Central palace, New York, is manager.

Dec. 6-8—

American Society of Refrigerating Engineers. Annual meeting to be held in New York. David L. Fiske, 37 West Thirty-ninth street, New York, is secretary.

Dec. 12-14—

National Warm Air Heating & Air Conditioning association. Annual meeting to be held in Cincinnati. Allen W. Williams, 50 West Broad street, Columbus, is secretary.

Dec. 12-15—

National Association of Coin-Operated Machine Manufacturers. Annual meeting and exhibit to be held at Stevens Hotel, Chicago. Clinton S. Darling, 120 South LaSalle street, Chicago, is secretary.

Jan. 6-14—

National Motor Boat Show. To be held at Grand Central Palace, New York. Henry R. Sutphen is president of the National Engine and Boat Manufacturers, 420 Lexington avenue, New York, sponsors of the show.

Jan. 9-13—

Society of Automotive Engineers Inc. Annual meeting to be held in Detroit. John A. C. Warner, 29 West Thirty-ninth street, New York, is secretary and general manager.

Jan. 22-27—

Canning Machinery and Supplies association. Annual meeting to be held at Chicago. S. G. Gorsline, Lock Box 430, Battle Creek, Mich., is secretary.

Jan. 23-27—

American Institute of Electrical Engineers. Winter convention to be held in New York. H. H. Henline, 33 West Thirty-ninth street, New York, is secretary.

Jan. 23-26—

American Society of Heating and Ventilating Engineers. Refrigeration and air conditioning accessories exhibition and annual meeting to be held at William Penn hotel, Pittsburgh. A. V. Hutchinson, 51 Madison avenue, New York, is secretary.

Jan. 24—

Canning and Packing Machinery institute. Annual meeting to be held in Chicago. E. G. Vail, 205 West Wacker drive, Chicago, is secretary.

Save with SEMS*

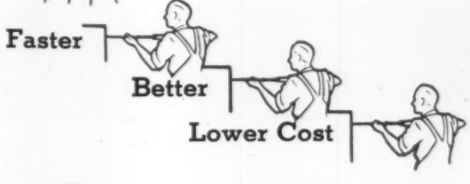
Can't COME OFF!

PRE-ASSEMBLED SHAKEPROOF LOCK WASHER AND SCREW

SEMS SAVE TIME AND MONEY!

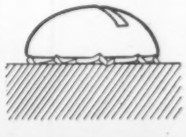
No more of this . . .

. . . . or this



Correct lock washer for each size and type of screw head

Every screw LOCKED TIGHT!



SHAKEPROOF'S *New Fastening Unit!*

SEMS offer every metal-working manufacturer a new opportunity to reduce costs and improve fastening efficiency. SEMS speed up production by saving time formerly wasted in putting lock washers on screws. The lock washer is held in its most efficient locking position and each screw has the correct size and type of lock washer for its particular head. Waste and loss of lock washers are eliminated because the lock washer cannot come off the screw. Ordering and stock control are simplified, for both screws and lock washers are delivered as one unit, preventing unbalanced inventories. Try this new Shakeproof fastening unit — mail the post card below for price information!

SHAKEPROOF LOCK WASHER CO.

Distributor of Shakeproof Products Manufactured by Illinois Tool Works

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Kindly send us price information on the sizes of SEMS listed below.

DESCRIPTION OF SCREW

Head	Diameter	Thread	Length	Finish

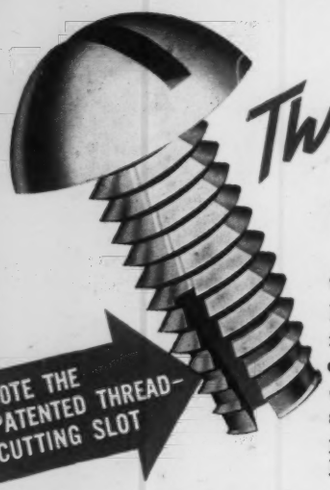
Firm Name _____

City _____ *State* _____

Signed by _____ *Title* _____

*SEMS is the trade-mark of Illinois Tool Works, manufacturers of Shakeproof Lock Washers. Only genuine Shakeproof Lock Washers are used in the manufacture of SEMS.

SHAKEPROOF



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The Only Screw that actually Cuts its Own Thread

TAP *and* FASTEN *in* ONE OPERATION

Here is the modern metal-to-metal fastening that enables faster production, lower assembly costs, and greater holding efficiency. No more expensive tapping—you simply punch or drill a hole, insert a Shakeproof Thread-Cutting Screw, and drive it home. The patented slot cuts a clean standard machine screw thread; and, because each screw remains in its own threads, a perfect fit and tight fastening are always secured. Write for test samples.

FASTENS METAL TO METAL SECURELY!

EASY TO START EASY TO DRIVE A PERFECT FIT

Triple-Action LOCK WASHERS

EXTERNAL TYPE

INTERNAL TYPE

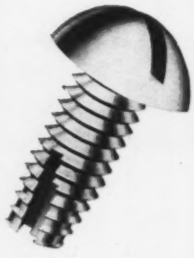
COUNTERSUNK TYPE

Here is the lock washer that thoroughly protects product performance, employing the proven Shakeproof principles of strut-action, spring-tension, and line-bite. It holds either nuts or screws absolutely tight even under severe vibration. Locking efficiency is actually improved as vibration increases. The tapered twisted teeth are forced deeper into both nut and work surfaces, setting up a more powerful lock. Regardless of the degree of vibration, the connection stays tight. Write for test samples today, indicating the types and sizes you desire.

STRUT-ACTION SPRING-TENSION LINE-BITE

"HI-HOOK" for all PLASTICS

This is a specially designed screw for plastic applications. Note the double-width thread-cutting slot which provides an acute cutting edge that enables easy driving in any plastic material, either molded or laminated. The screw cuts its own thread, eliminating the need for a separate tapping operation or costly threaded inserts. Send for your test samples.



"LOCKING" for Intense Vibration

The Shakeproof Locking Thread-Cutting Screw is recommended as a permanent fastening for assemblies subjected to severe vibration which need not be dismantled for frequent servicing. Patented locking projections under the head imbed themselves into the work, powerfully resisting any backward movement of the screw. Testing samples will be sent on request.

LOCKING TERMINALS

Shakeproof offers a broad line of locking terminals to fill the varied needs of the electrical appliance industries. Cost savings are achieved by combining both soldering lug and lock washer in one piece, eliminating the need for a separate lock washer. Plain terminals are also available. Advise the type of terminal and screw size desired, and samples will be sent on request.

Postage Will Be Paid by Addressee

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 243 SEC. 510, P. L. & R. CHICAGO, ILL.

SHAKEPROOF LOCK WASHER CO.

2551 NORTH KEELER AVENUE

CHICAGO, ILLINOIS

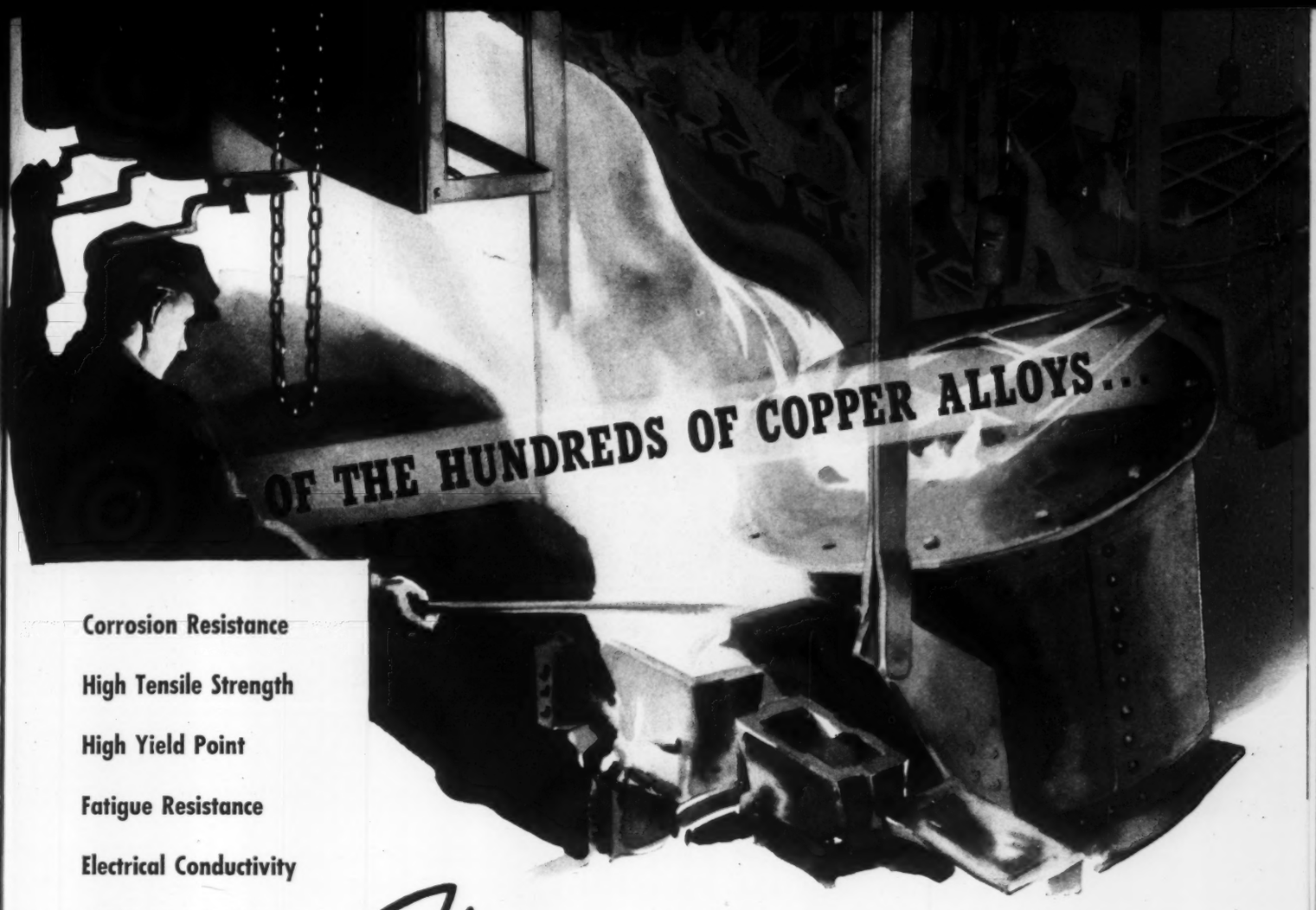
SHAKEPROOF Lock Washer Co.

Distributor of Shakeproof Products Manufactured by Illinois Tool Works

2501 North Keeler Avenue, Chicago, Illinois

IN CANADA: Canada Illinois Tools, Ltd., Toronto, Ont.

Copyright 1938 Illinois Tool Works



Corrosion Resistance

High Tensile Strength

High Yield Point

Fatigue Resistance

Electrical Conductivity

Thermal Conductivity

Machinability

Ductility

Hardness

Toughness

Resistance to Abrasion

Hot or Cold Workability

Resistance to Arcing

Non-magnetic

Weldability

There is ONE best suited to your needs

COPPER and its many useful alloys possess a range of physical properties not found in other metals. Yet, these properties singly or in combination can be varied to a considerable extent by metallurgical adjustment of composition and by the method of fabrication. • While copper alloys in general are extensively employed for their corrosion resistance, ready workability and enduring qualities, maximum performance and economy are obtainable only by selecting the *one* alloy *best* suited to the purpose. Competent Service Engineers, backed by an experienced Technical Department, are prepared to help you find the answer in terms of your own product.

THE AMERICAN BRASS COMPANY

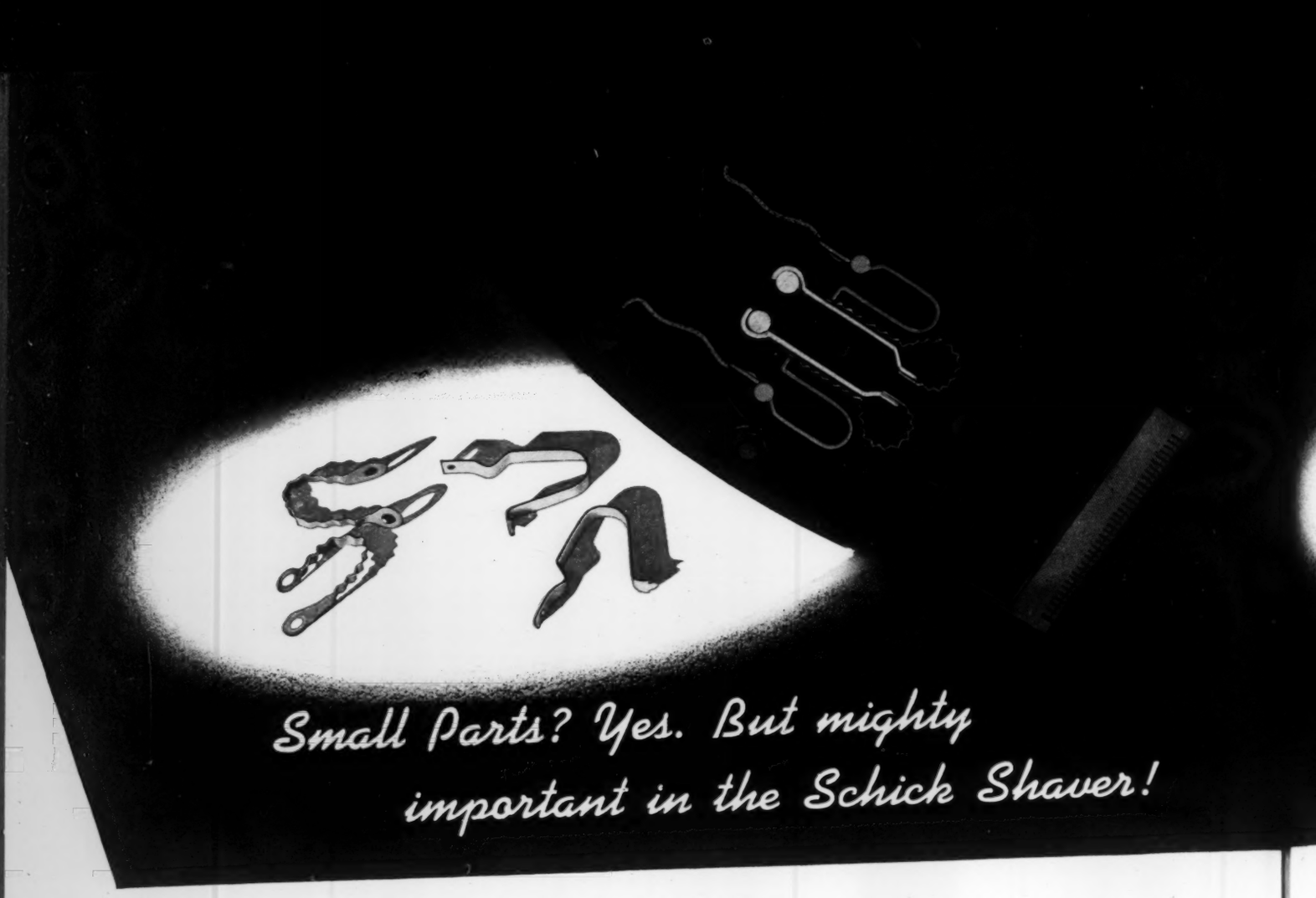
General Offices: Waterbury, Connecticut • Subsidiary of Anaconda Copper Mining Company

ANACONDA
from mine to consumer

Anaconda Copper & Copper Alloys

*Trade-marks registered in U. S. Patent Office

• EVERDUR* • TOBIN* BRONZE • PHOSPHOR BRONZE •



Small Parts? Yes. But mighty important in the Schick Shaver!

ANACONDA BERYLLIUM COPPER

AVAILABLE PROPERTIES

- Fatigue Resistance
- High Tensile Strength
- High Modulus of Elasticity
- High Proportional Limit
- Corrosion Resistance
- Conductivity
- Hardness
- Spring Qualities
- Resistance to Wear
- Workability
- Ductility

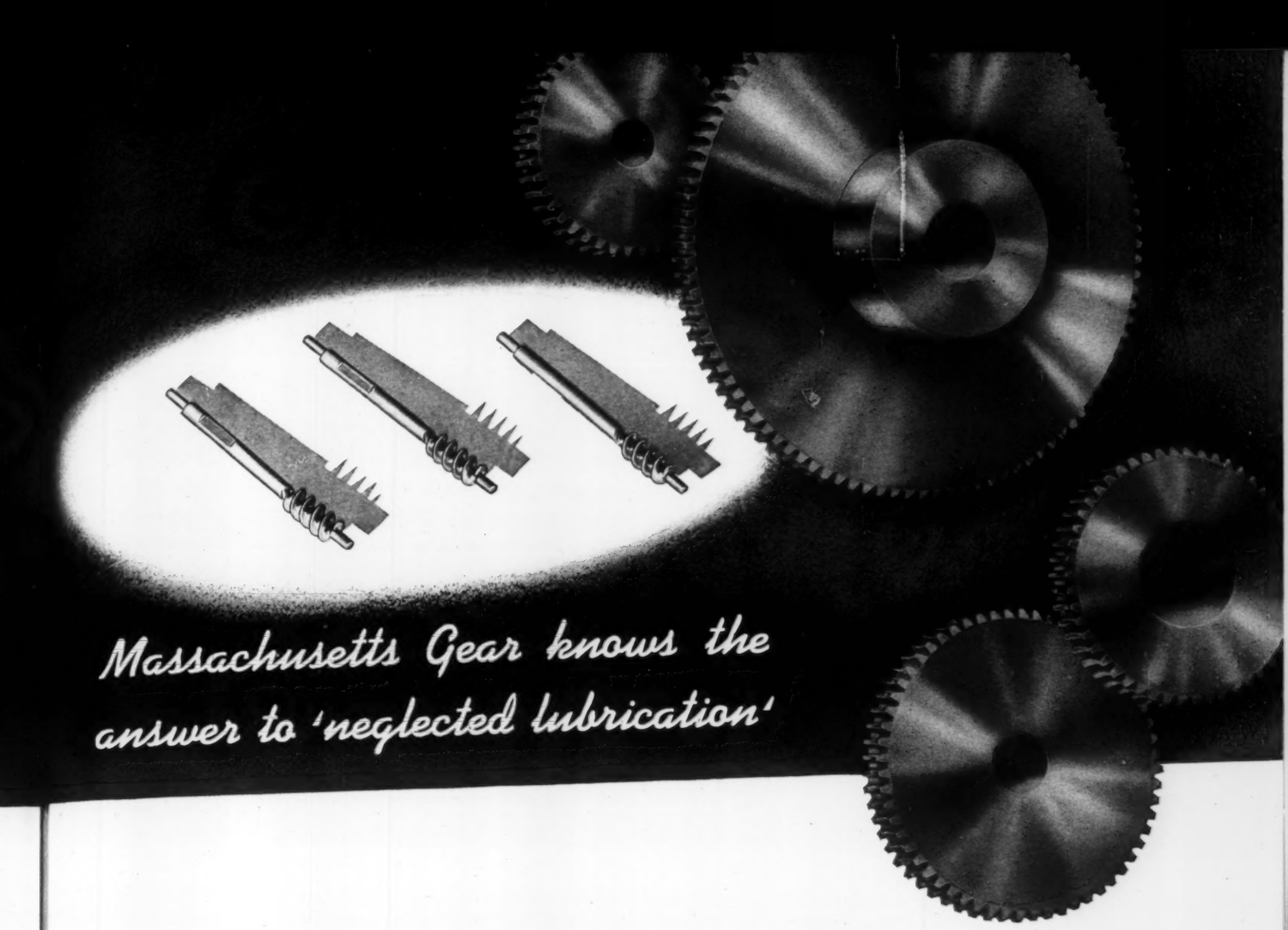
The two corrugated stampings are used for dissipating the heat emanating from the breaker-points; the contact springs are formed soft, then heat treated for spring qualities. Both are made of Anaconda Beryllium Copper to withstand the high speed vibration of 200 cycles per second. A "run to destruction" test on the Schick Shaver indicated a motor life equivalent to more than half a century of shaves. Only a metal with the unusually high fatigue resistance of this Anaconda Alloy could meet this test! ● Many manufacturers, especially in the electrical industry, have found that the unusual life of Anaconda Beryllium Copper under repeated stresses results in a higher quality product and savings in replacement cost. Anaconda Beryllium Copper, with the addition of nickel, is an exclusive and patented development. Parts can be formed and machined from this metal in its softest form, then heat treated to a strength and hardness exceeding any other copper alloy. It is available in plates or sheets, strips, wire and rods. Complete information is available in Publication B-21. Write The American Brass Company, General Offices, Waterbury, Conn.

ANACONDA
from mine to consumer
REG. U.S. PAT. OFF.

Anaconda

*Trade-marks registered in U. S. Patent Office

• AMBRAC* • NICKEL SILVER • SUPER NICKEL •



Massachusetts Gear knows the answer to 'neglected lubrication'

ANACONDA PHOSPHOR BRONZE

PRINCIPAL PROPERTIES

- High Tensile Strength
- High Elastic Limit
- Corrosion Resistance
- Resistance to Fatigue
- Low Coefficient of Friction
- Resistance to Compression
- Machinability (free-cutting alloy)
- Resistance to Abrasion
- Resistance to Arcing

The small worm gears illustrated are used in an accurate recording device frequently installed in places where periodic lubrication cannot be expected. Frequent failures were experienced previous to the use of free-cutting Anaconda Phosphor Bronze. This material machines easily and can be readily polished to the finish necessary for the successful operation of sensitive devices. In addition to its excellent wear resisting qualities, this popular Anaconda Alloy possesses many desirable properties which make it especially adaptable to the bar stock production of various types of worms, gears, pinions, bushings, bearings, valve and pump parts and similar engineering equipment. • Anaconda Phosphor Bronze is furnished in six standard alloys (including a special free-cutting alloy) which vary in proportions of tin and phosphorus contents. It is available in sheets, strips, tubes, rods and wire. In the form of suitably tempered sheets and strips it is used extensively in the manufacture of springs, switches, fuse clips and many other electrical specialties where its high fatigue resistance provides unusually long life. • Write for Anaconda Publication B-15.

Copper & Copper Alloys

L • TEMPALOY* • BERYLLIUM COPPER • AMBRALOY* •

American Screw wanted a tough metal that could take a beating

EVERDUR (COPPER-SILICON-MANGANESE ALLOYS)

PRINCIPAL PROPERTIES

- Corrosion Resistance
- High Tensile Strength
- High Yield Point
- Toughness
- Hot or Cold Workability
- Weldability
- Machinability
- Ductility
- Non-magnetic

Everdur has an enviable reputation for being a strong, tough, workable, corrosion-resistant metal. In fact, it was developed for structural and engineering uses requiring a metal with the strength of steel and corrosion resistance of copper. So, when silicon-manganese bronze screws were added to the line of fast-driving American PLUS Phillips Head Screws, Everdur Metal provided all the necessary properties; high strength, toughness, ductility, high fatigue limit and freedom from brittleness—plus the ability to withstand severe cold heading operations. Tests on cold headed, roll threaded Everdur bolts and screws indicate tensile strengths of more than 85,000 lb. per sq. in. The Everdur rod used for such products has a yield point (at ½ of 1% extension) of more than 60,000 lb. per sq. in., and a minimum elongation of 8% in 2". ● Everdur wood screws are the standard fastening material for many motorboats, yachts, and cruisers. In the electrical field, millions of Everdur bolts, both hot forged and cold headed, and other items of outdoor connectors and pole line hardware have proven their value under unusual service conditions of corrosion and stress. ● Considering its many desirable properties and moderate price, this workable and weldable Trade-Marked Alloy is decidedly economical to use. It is available in all commercial forms and in four standard compositions, suitable for hot or cold working, casting or screw machine production. Write for Anaconda Publication E-5.

ANACONDA
from mine to consumer

THE AMERICAN BRASS COMPANY

General Offices: Waterbury, Connecticut • Subsidiary of Anaconda Copper Mining Company

MANUFACTURING PLANTS—Ansonia, Conn. • Buffalo, N.Y. • Detroit, Mich. • Kenosha, Wis. • Torrington, Conn. • Waterbury, Conn.

OFFICES AND AGENCIES—Atlanta, Ga. • Boston, Mass. • Buffalo, N. Y. • Chicago, Ill. • Cincinnati, Ohio Cleveland, Ohio • Denver, Colo. • Houston, Texas • Kenosha, Wis. • Los Angeles, Calif. • Newark, N. J. • New York, N. Y. Philadelphia, Pa. • Pittsburgh, Pa. • Providence, R. I. • Rochester, N. Y. • St. Louis, Mo. • San Francisco, Calif. • Seattle, Wash. Syracuse, N. Y. • Washington, D. C. • Waterbury, Conn.

WAREHOUSES: Chicago, Ill. • Cleveland, Ohio • Philadelphia, Pa. • Providence, R. I.
The American Brass Company of Texas, Houston, Texas

IN CANADA: Anaconda American Brass Limited. Manufacturing Plant and General Office, New Toronto, Ontario
Montreal Office: 1010 St. Catherine Street, West

Anaconda Copper & Copper Alloys

DM 387

• WELDING RODS • DIE PRESSED PARTS

MANUFACTURERS' *publications*

BEARINGS (BALL)—Catalog No. 106 has been issued by the Nice Ball Bearing Co., Nicetown, Philadelphia, giving specifications, drawings, ratings, and prices of its various bearings.

CASTINGS — A new booklet has been published by The Chicago Hardware Foundry Co., North Chicago, giving designers information on efficient use of ferrous and nonferrous cast parts for machines.

CASTINGS (ALLOY STEEL)—A new bulletin issued by the American Manganese Steel division of the American Brake Shoe & Foundry Co., Chicago Heights, Ill., illustrates uses of Amsco-Alloy steel castings in various machine and industrial applications, and gives physical details and properties.

CASTINGS (ALLOY STEEL) — Michiana Products Corp., Michigan City, Ind., has just issued booklet 108, containing essential data and information on how heat and corrosion resistant alloy steel castings should be specified.

CASTINGS (GRAY IRON)—Nickel Cast Iron Data Sheet Section 1 No. 1 has been published by the International Nickel Co. Inc., New York, presenting information for the selection of engineering specifications for gray cast iron to secure numerous properties.

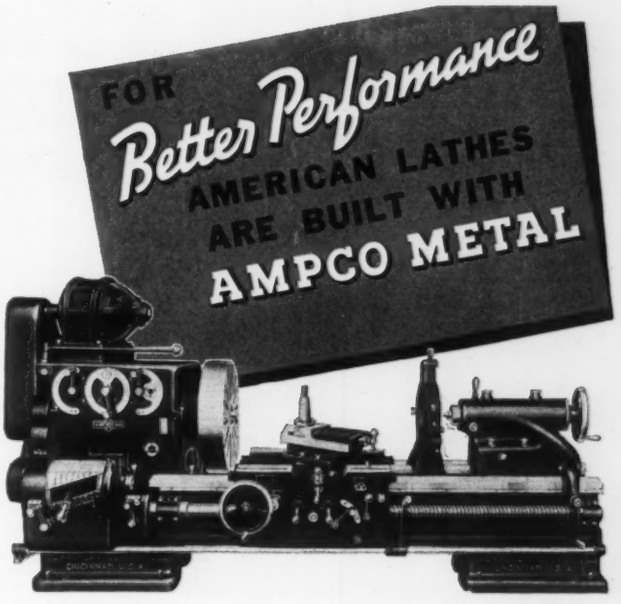
CASTINGS (ZINC ALLOY)—The New Jersey Zinc Co., New York, in a new brochure shows designers how zinc alloy die castings and rolled zinc should be finished in order to give the most satisfactory results when used in machines.

CLUTCHES (MAGNETIC) — General descriptions and design features of single and multiple-disk magnetic clutches made by the Stearns Magnetic Mfg. Co., Milwaukee, are set forth in bulletin 225, just published.

DRIVES (BELT)—A new leaflet on 2-3-4 adjustable single-groove combination sheaves has been released by the Texrope division of the Allis-Chalmers Mfg. Co., Milwaukee. The leaflet, No. 2333, shows how the outer sheave plate can be reversed for greater speed range without removing the sheave from its shaft.

FORGINGS — Kropp Forge Co., 5301 West Roosevelt road, Chicago, has issued a bulletin describing its "tailor-made" forgings and telling of their use in machines.

INSTRUMENTS (ELECTRICAL)—A new 216-page catalog issued by General Radio Co., Cambridge, Mass., lists uses, descriptions, features and specifications of



FOR sustained precision and wear resistance the vital units of American Lathes—such as the compensating cross feed nuts, the compound rest nuts, the threading dial worm wheels—are regularly made of Ampco Metal.

Machine tool builders find Ampco Metal invaluable in meeting high standards of construction and performance. For the complete facts send for "Ampco Metal—Its Uses in Modern Industry."

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In some one of its six grades Ampco Metal can very probably solve a problem for you . . . why not check with us.

The book "Ampco Metal—Its Uses in Modern Industry" will interest you; write for a copy.

AMPCO METAL

"The Metal without an Equal"

BEFORE YOU SPECIFY . . . INVESTIGATE AMPCO

New TRANSMISSION SAVES $ $ $

IDEAL "Select-O-Speed"

"Select-O-Speed" Variable Speed Transmissions are easily adaptable to all kinds of machine tools, conveyor belts, stokers, etc.—both old and new. Modernizes old machinery.

Inexpensive

USES STANDARD "V" BELTS

SIZES UP TO 7½ H. P.

A mere movement of the control lever makes possible selection of any one of an infinite number of speeds through a 5 to 1 range. Changes speeds for different jobs or different operations on same job—while machine is running!

"Select-O-Speed" comes as a complete unit ready to set in place. As easy to install as a "V" belt drive. Can be mounted on floor, ceiling, wall or right on machine.

Investigate today—*"Select-O-Speed"* improves production—saves money.

Transmission Division

IDEAL COMMUTATOR DRESSER COMPANY

1059 PARK AVENUE SYCAMORE, ILLINOIS

RAYMOND SPRINGS

RAYMOND MFG. CO.

DIVISION OF ASSOCIATED SPRING CORPORATION

280 So. Centre St. - - - CORRY, PA.

the varied line of General Radio electrical equipment including transformers, condensers, stroboscopes, sound meters and analyzers, etc.

LUBRICATION—Lubriplate division, Fiske Brothers Refining Co., Newark, N. J., has issued a new bulletin B-100 entitled, "Life Expectancy of Mechanical Equipment," in which the importance of proper lubrication is brought out.

MOTORS — An unusual brochure has been released by the Dumore Co., Racine, Wis., consisting of reprints of Dumore's 1938 series of advertisements, which point to technical features and design details of various fractional-horsepower motors.

PLASTICS—Dilecto, a laminated phenolic plastic developed as a waterproof insulating material with great mechanical strength and adaptability, is described in a new catalog published by Continental-Diamond Fibre Co., Newark, Del.

PNEUMATIC EQUIPMENT — Five types of Nopak cushioned air cylinders with nonadjustable cushion-heads are described in a new booklet issued by the Galland-Henning Mfg. Co., Milwaukee. Dimensions are listed.

STEEL (ALLOY)—Some of the machine parts made from alloy steel are shown in a brochure issued by Allegheny Ludlum Steel Corp., Brackenridge, Pa., which also explains the products, plans, and facilities of the new concern.

SURFACING MATERIAL—A new booklet has been published by American Chemical Paint Co., Ambler, Pa., pointing out how the "breaking-in" period of machines can be made less difficult through application of Thermoil-Granodine to the surfaces of moving parts. Thermoil-Granodine reduces friction.

VALVES (SOLENOID)—Automatic Switch Co., New York, has released a new ten-section catalog describing and illustrating its complete line of solenoid-operated valves for automatic and remote control of air, gas, steam, liquids.

VARIABLE SPEED TRANSMISSION—A self-contained mechanical speed-reducing transmission with speed infinitely and instantly adjustable is described in a new catalog issued by The Lenney Machine & Mfg. Co., Warren, O.

WELDING — The Lincoln Electric Co., Cleveland, has published bulletin 401-A, which supplies engineers with information on how welding of all kinds of industrial metals may be best applied in the design of machinery. Practical examples are shown.

WELDING—"The Welder's Trouble Shooter," an 8-page booklet issued by the Westinghouse Electric & Mfg. Co., East Pittsburgh, shows how the common troubles met by welders may be avoided through proper design of parts.

Business and Sales Briefs

Following appointments have been made by Foote Bros. Gear & Machine Corp., Chicago: Murray-Baker-Frederick Co., 715 Linden avenue, Shreveport, La., as district representative for Northern Louisiana and Southern Arkansas; and Lloyd C. Taylor, P. O. Box 113, Richmond, Va., as district representative for gear and reducer products of the company for the state of Virginia.

♦

George Reindel Jr. has been appointed district manager at Detroit for the Emerson Electric Mfg. Co., St. Louis.

♦

Offices of the Universal Plastics Corp. have been moved to 12 East Forty-first street, New York.

♦

Jerry F. Howard has been made representative in New York for the plastics division of Gorham Co. His headquarters will be 6 West Forty-eighth street.

♦

Bantam Bearings Corp., South Bend, Ind., a subsidiary of Torrington Co., Torrington, Conn., has appointed George H. Spencer to take charge of the New England district and also to act as paper machinery specialist in the application of bearings.

♦

Recent announcement has been made of the appointment of C. E. Phillips & Co., 2750 Poplar street, Detroit, as exclusive sales representative of the Union Chain & Mfg. Co., Sandusky, O. The company will now be in a position to give aid in materials handling and transmission problems in that region.

♦

Harvey Nicholson, St. Louis, a graduate of the Missouri School of Mines and Metallurgy, Rolla, Mo., has been added to the laboratory staff of the Stearns Magnetic Mfg. Co., Milwaukee.

♦

V. A. Jevon, district sales manager, Baltimore office, Jones & Laughlin Steel Corp., has been appointed assistant to the vice president in charge of sales. He has been succeeded in his former position by Henry R. Dorney, previously assistant district sales manager at Baltimore.

♦

John Kirgan has been appointed New York manager for Crane Packing Co., Chicago. He formerly was associated with the Ingersoll-Rand Co., Phillipsburg plant.

♦

Newly formed by Owens-Illinois Glass Co. and Corning Glass Works, the Owens-Corning Fiberglas Corp. will have headquarters in Toledo, O., and plants in

A new avenue of approach on tough design problems

● Would a new motion, a new function, a new controllability, smoothness and flexibility of power add *salability* to your product?

Then turn to Oilgear Fluid Power . . . which may quite likely be the opening to a vista of untouched design possibilities so rich as to be just the tool you have been looking for.

Oilgear Fluid Power transforms energy from any constant speed source into rotating or reciprocating motion of steplessly variable speed, forward or reverse. The heart of Oilgear, the efficient Oilgear pumping mechanism, transforms mechanical power into an oil flow, in turn converted into controllable rotation in an Oilgear oil-motor or into controllable reciprocating motion in an Oilgear cylinder. The medium of transmission, oil, results in cushioned power, simple but positive control, self-lubrication, high efficiency and negligible maintenance.

Don't compare or limit Oilgear Fluid Power in terms of conventional means. The big, vital factor about Oilgear is its APPLICABILITY. THE OILGEAR COMPANY, 1321 W. Bruce St., Milwaukee, Wis.

OILGEAR

Fluid Power

VARIABLE SPEED SYSTEMS

Newark, O., and Corning, N. Y. The company has been formed to put into many new fields the application of recent developments in glass fiber and glass textiles during the last three years. Harold G. Boeschenstein, formerly vice president and general manager of the Owens company is president of the new firm, and Amory Houghton, president of Corning, will be chairman of the board of directors.

♦

Flexible Steel Lacing Co., Chicago, has named Austin Webster, who has been connected with the company for the past 16 years, as its resident sales representative in the southeastern states.

♦

George R. Gregg has been appointed representative in the Pittsburgh area by Michiana Products Corp., Michigan City, Ind. Mr. Gregg's offices are in the Clark building.

♦

Formerly assistant general sales manager, T. D. Cartledge has been appointed general sales manager of Linde Air Products Co., unit of Union Carbide & Carbon Corp.

♦

Appointment of William P. Langworthy as director of electrical materials division, Allegheny Ludlum Steel Corp., Pittsburgh, has recently been made. He was formerly president of Lamination Stamping Co., Hartford, Conn., and in 1930 when the company was merged with Allegheny Steel Co., he became manager of the fabrication division, the position he has held until his present appointment.

♦

O. Smalley, president of Meehanite Metal Corp., Pittsburgh, was re-elected president of the Meehanite Research institute at the recent annual meeting of that organization held in Rochester, N. Y. H. B. Hanley, foundry manager of the American Laundry Machinery Co., Rochester, N. Y., is vice president.

♦

Manhattan Rubber Mfg. division of Raybestos-Manhattan Inc., Passaic, N. J., has recently observed its forty-fifth anniversary of the founding and incorporation of The Manhattan Rubber Mfg. Co., original name of the company until its merger in 1929. The company today is said to be one of the world's largest manufacturers of mechanical rubber goods.

♦

Alan Wood Steel Co., Conshohocken, Pa., has appointed Edward H. Lloyd as representative in the New England district.

♦

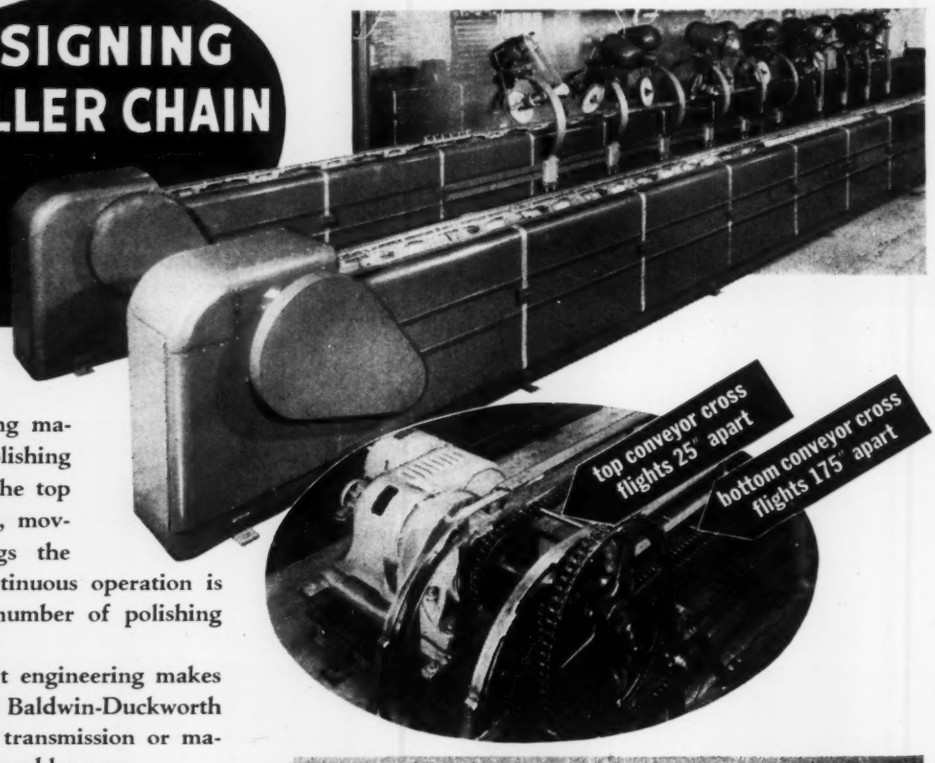
Frank Webster, previously connected with Vitreous Enameling Co., Cleveland, has joined Ferro Enamel Corp., Cleveland, as an enamel sales and service man.

♦

Associated with American Steel & Wire Co., Cleveland, for about 34 years, and since 1925 a salesman in the manufacturers department, H. C. Pearson has now been appointed assistant manager of sales, New England district, with headquarters in Boston.

SMART DESIGNING AND B-D ROLLER CHAIN

Save $7200.00



● These Udymatic polishing machines accommodate 32 $225 polishing fixtures on the cross flights of the top conveyor. The bottom conveyor, moving seven times as fast, brings the heads back so rapidly that continuous operation is maintained with one half the number of polishing fixtures.

Roller Chain plus intelligent engineering makes savings like this possible. Give a Baldwin-Duckworth Engineer a look at some power transmission or material handling problem which troubles you.

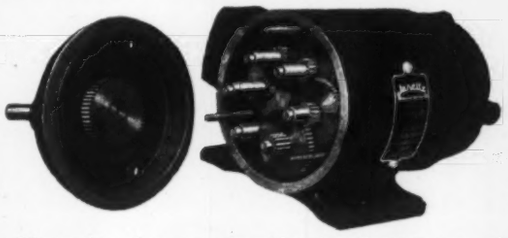
BALDWIN-DUCKWORTH CHAIN CORPORATION
Springfield, Massachusetts
FACTORIES AT SPRINGFIELD and WORCESTER, MASSACHUSETTS

BALDWIN DUCKWORTH

Janette
MOTORIZED SPEED REDUCERS

10 DIFFERENT STYLES
1/50 TO 7½ H. P.

Designed — Built — Tested — Guaranteed
As A Complete—Compact Unit—By
One Organization—No Divided Responsibility.



Illustrating the gear assembly of a Special type of multiple spur gear reducer.

The diversity of the Janette custom built line of motorized speed reducers enables us to supply a machine from 1/50 to 7½ H.P. for almost any purpose. You can select the style of compact, rugged Janette speed reducer that meets your individual requirements, without the necessity for using expensive adaptors or modifications.

MAY WE HAVE YOUR REQUIREMENTS

Rotary Converters—Generators—Motors—Motor-Generators

Janette Manufacturing Company
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BOSTON - NEW YORK - PHILADELPHIA - CLEVELAND - MILWAUKEE - LOS ANGELES
DETROIT - SEATTLE

NOT THE LARGEST . . . *but*

BIG ENOUGH

TO MEET YOUR SPECIALIZED CONTROL REQUIREMENTS — ANY QUANTITY AS YOU WANT THEM — WHEN YOU WANT THEM.

Engineering Laboratory — *devoted solely to the design of electrical control units from simple to most intricate combinations . . . uniform in size . . . space-saving . . . simple, better and more economical.*

Type-R Stepping Relay

Above—Guardian Electric's production lines where innumerable types of control units arrive from other departments for final assembly. These may comprise relays, discs, contact combinations, stepping switches, solenoids, springs, auxiliary time delay, muting and holding relays, metal housings and brackets, and other special parts. All these flow together smoothly in the hands of competent, trained electrical workers . . . and every part is designed, fabricated, tested, and assembled in one plant . . . Guardian's!

Ask Us To Make Specific Recommendations To Fit Your Special Requirements. Write For Catalog D Today!

GUARDIAN ELECTRIC
1621 W. Walnut St. Chicago • Illinois

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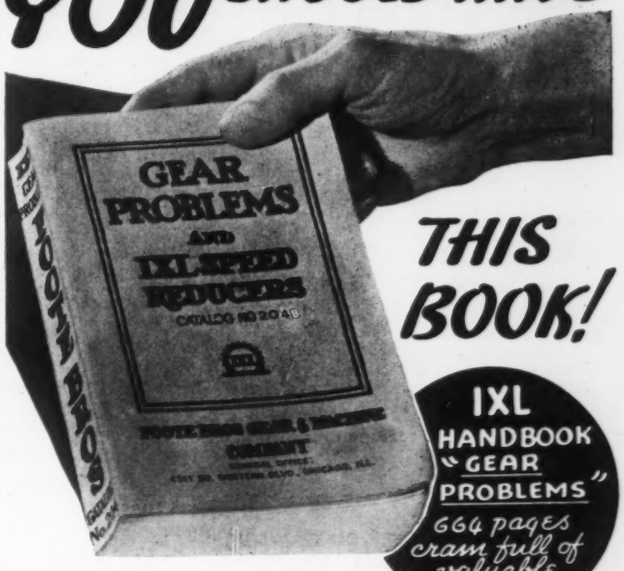

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IT'S an indispensable guide for those interested in any gearing problem—it has page after page of data, tables and formulae useful in almost any phase of engineering. It's yours—free. Just fill out and mail the convenient coupon below.

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City..... *State*.....

NEW MACHINES—
And the Companies Behind Them

(For illustrations of other outstanding machinery see Pages 42-43)

Agricultural
Deluxe model tractor, Minneapolis-Moline Power Implement Co., Minneapolis.

Air Conditioning
Winter air conditioner, George Evans Corp., Moline, Ill.
Stoker, Econ-O-Col Stoker Div., Cotta Transmission Corp., Rockford, Ill.

Automotive
Combination grinding and turning machine, Lempco Products Inc., Bedford, O.
Body and fender straightening tool, Ingersoll-Rand Co., Phillipsburg, N. J.

Brewery
Trub press, Ludwig Baer, New York.
Heat exchanging apparatus, Walker-Wallace Inc., Chicago.

Ceramics
Dustless dryer, Hardinge Co., York, Pa.
Plain pallet stripper, Besser Mfg. Co., Alpena, Mich.
Mixer, Multiplex Concrete Machinery Co., Elmore, O.
Glass batch mixer, Chain Belt Co., Milwaukee.

Confectionery
Disc conche machine, J. M. Lehmann Co. Inc., New York.
Chocolate coating machine, J. W. Greer Co., Cambridge, Mass.
Bar molds washing machine, Wisner Mfg. Corp., New York.

Construction
Trench roller, Galion Iron Works & Mfg. Co., Columbus, O.
Maintainer-grader, Good Roads Machinery Corp., Kennett Square, Pa.
Earth borer, Four-Wheel Drive Auto Co., Clintonville, Wis.
Bucket type truck, Zenner Bros., Long Island City, N. Y.

Dairy
Vacuum milk filler-capper, Crown Cork & Seal Co., Baltimore, Md.
Automatic bottle washer, Enzinger Union Corp., Angola, N. Y.

Domestic
Stoker, Meier Electric & Machine Co., Indianapolis.

Food
High speed bolter, Great Western Mfg. Co., Leavenworth, Kans.
Pellet mill, California Pellet Mill Co., San Francisco.
Horizontal mixer, Fairfield Engineering Co., Marion, O.
Rotary press, Helm Mfg. Co., Fort Worth, Tex.
Granulator, Jabez Burns & Sons Inc., New York.
Quick freezing unit, Chas. H. Welling & Co. Inc., New York.

Hotel
Automatic floor scrubber, Lincoln-Schlueter Floor Machinery Co., Chicago.

Industrial
Heavy-duty vacuum cleaner, Arc Vacuum Corp., New York.
Automatic degreasers, Detroit Rex Products Co., Detroit.
Electric furnace cleaner, General Electric Co., Schenectady.

Laboratory
Electric incubator for methylene blue tests, Loose-Products Co., Herbon, Ill.

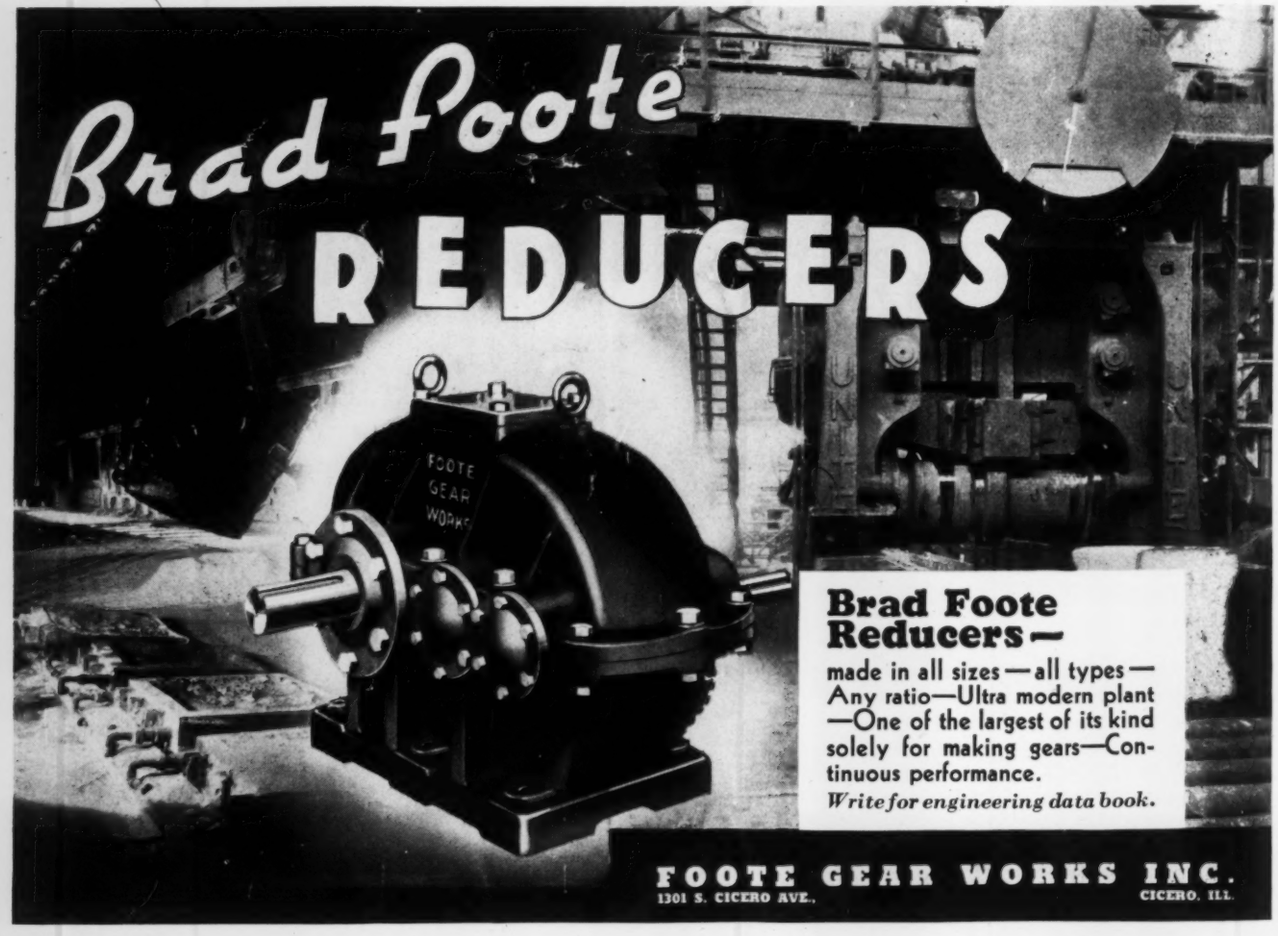
Laundry
Foot-operated laundry press, American Laundry Machinery Co., Cincinnati.

Materials Handling
Hydraulic powered cargo packer, Denison Engineering Co., Columbus, O.
Self-feeding bucket loader, Barber-Greene Co., Aurora, Ill.
Truck crane, Bay City Shovels Inc., Bay City, Mich.
Hand lift truck, Yale & Towne Mfg. Co., Philadelphia.
Motor-driven trolley hoist, American Engineering Co., Philadelphia.
Tinplate handling lift truck, Revolvator Co., North Bergen, N. J.

Mining
Laboratory mill, O. B. Wise Co., Knoxville, Tenn.
Excavator, Lima Locomotive Works Inc., Lima, O.
Foam-liquid slime pump, Bingham Pump Co., 705 E. Main St., Portland, Oreg.
Electro-magnetic vibrating grizzly feeder and hammer mill, Allis-Chalmers Mfg. Co., Milwaukee.
Stoker breaker, McNally Pittsburgh Mfg. Corp., Chicago.

Plastic
Automatic injection molding machine, Index Machinery Corp., Cincinnati.

Quarry
Load lugger for transporting stone, Brook Equipment Mfg. Co., Knoxville, Tenn.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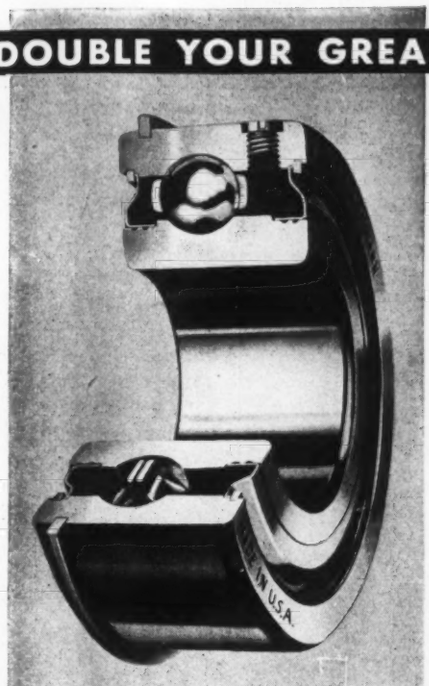

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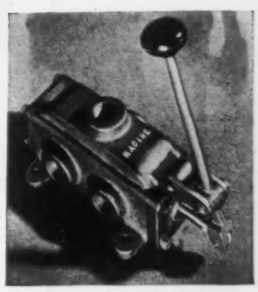

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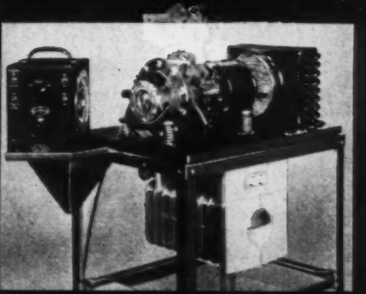

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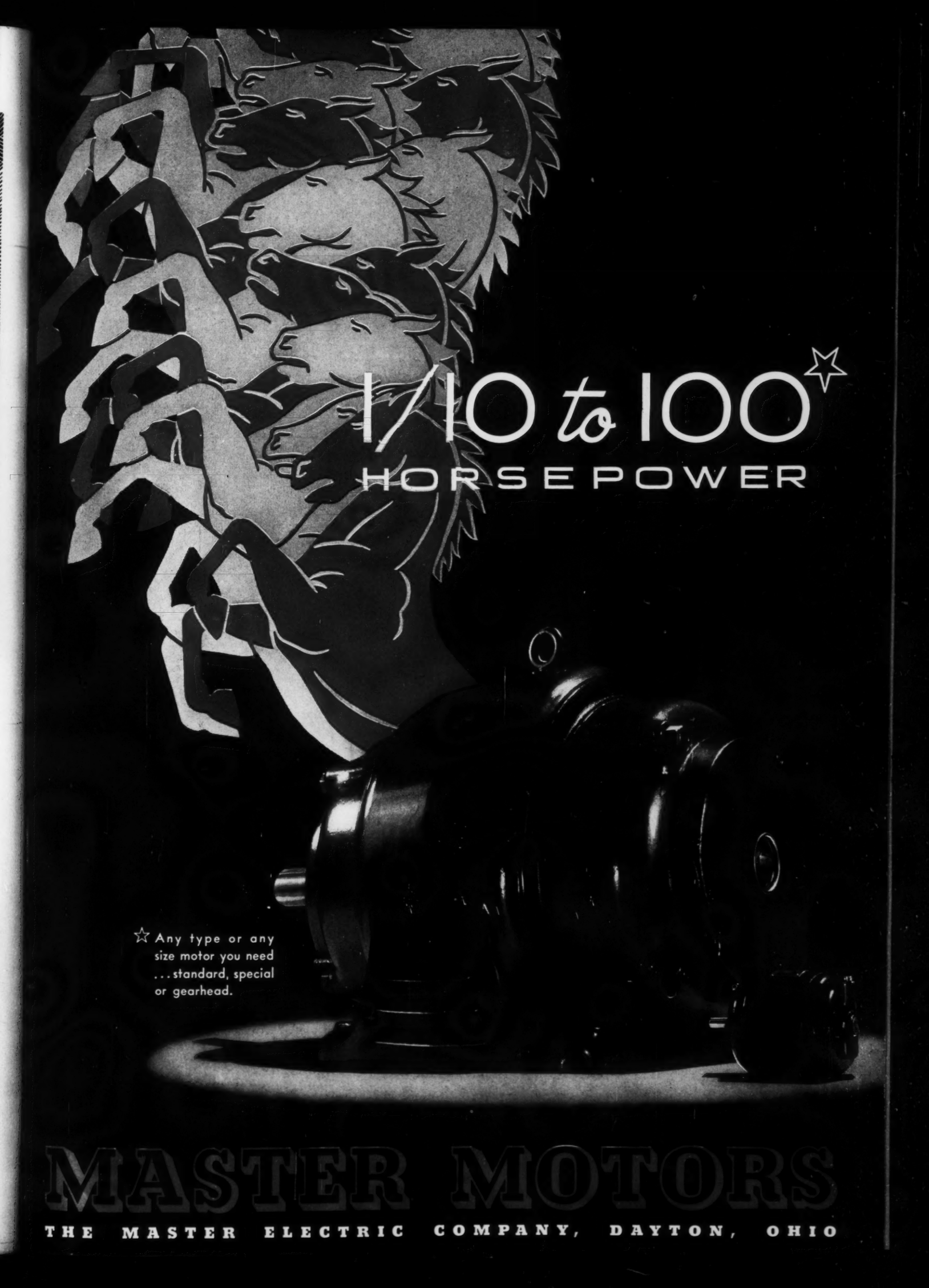
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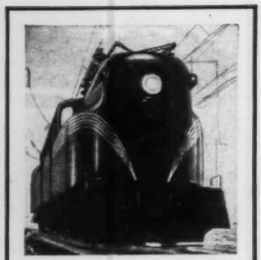

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